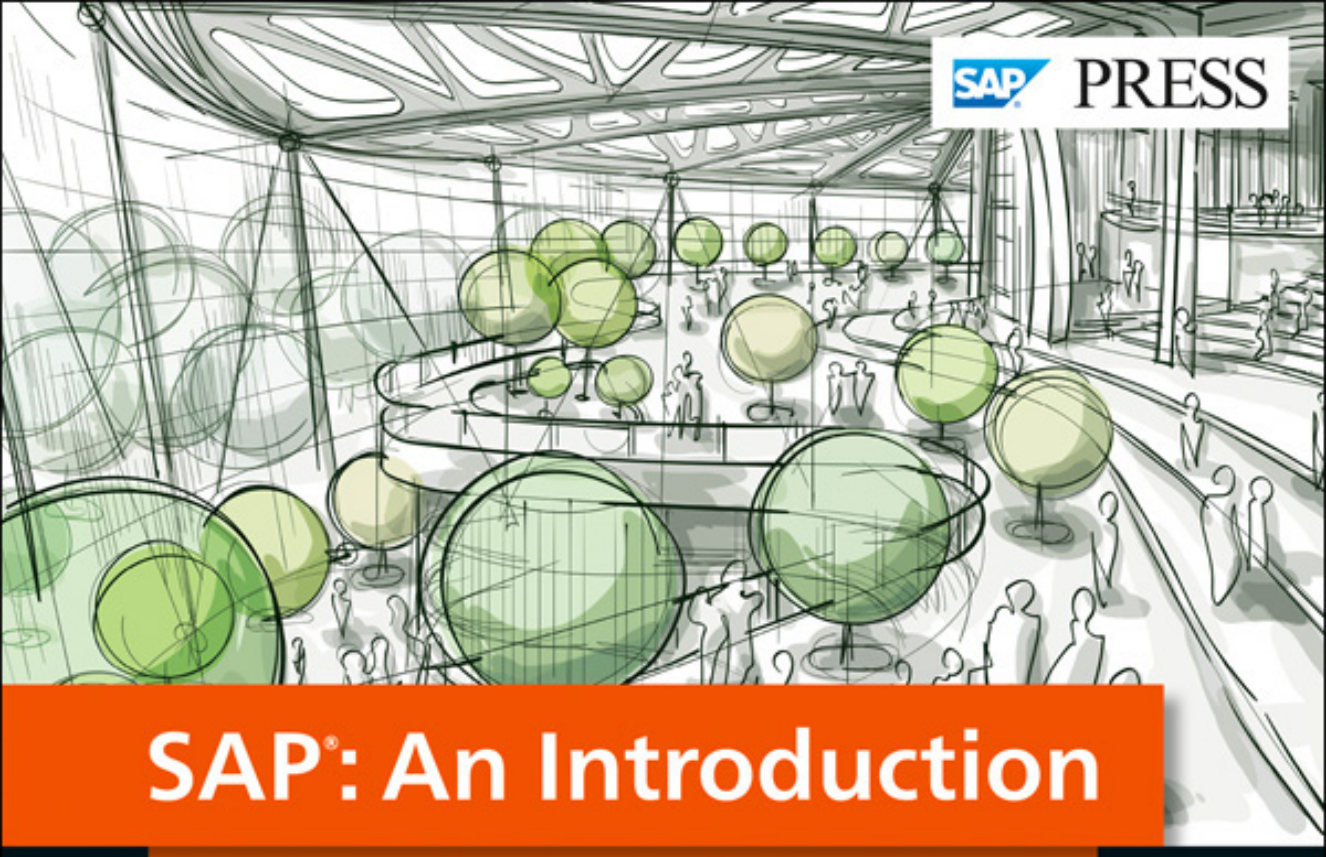

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Dear Reader,

I've always associated transformation with butterflies.

From caterpillar to chrysalis to butterfly, this iconic metamorphosis is straightforward, elegant, and predictable. Each butterfly we see floating on a breeze has undergone it and thrived.

However, it's harder to apply these three descriptors to transformation in the business world. Here, there's no such thing as growth inside the safe seclusion of a chrysalis; instead, today's SAP customers face a harsh environment characterized by global competition and constant disruption. IT budgets are tight. Consumer demands change over time. Software portfolios evolve, and so do the options for implementing them.

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Thank you for purchasing a book from SAP PRESS!

Megan Fuerst
Editor, SAP PRESS

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Editor Megan Fuerst
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Production E-Book Kelly O'Callaghan
Typesetting E-Book SatzPro, Krefeld (Germany)

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The Library of Congress has cataloged the printed edition as follows:
Names: Riches, Matthew, author.
Title: SAP, next generation / Matthew Riches [and three others].
Description: 1st edition. | Bonn ; Boston : Rheinwerk Publishing, [2018] |
Includes index. |
Identifiers: LCCN 2018035402 (print) | LCCN 2018037485 (ebook) | ISBN
9781493216512 (ebook) | ISBN 9781493216505 (alk. paper)
Subjects: LCSH: SAP ERP. | Management information systems. | Client/server
computing. | Business--Data processing.
Classification: LCC HD30.213 (ebook) | LCC HD30.213 .R527 2018 (print) | DDC

ISBN 978-1-4932-1650-5 (print)
ISBN 978-1-4932-1651-2 (e-book)
ISBN 978-1-4932-1652-9 (print and e-book)

© 2019 by Rheinwerk Publishing, Inc., Boston (MA)
1st edition 2019

Contents

Preface 19
Introduction 29

PART I Customer Experience

1 Customer Experience with SAP C/4HANA 47

1.1 Business Case 49

1.2 Marketing 51
1.2.1 Challenges in Marketing 51
1.2.2 SAP Marketing Cloud 55
1.2.3 SAP Acquisitions in Marketing 61

1.3 Sales 62
1.3.1 Challenges in Sales 63
1.3.2 SAP Sales Cloud 66

1.4 Commerce 70
1.4.1 Challenges in Commerce 71
1.4.2 SAP Commerce Cloud 73

1.5 Customer Service 75
1.5.1 Challenges in Customer Service 77
1.5.2 Customer Service Channels 78
1.5.3 SAP Service Cloud 80

1.6 Data 83
1.6.1 Challenges in Data 84
1.6.2 SAP Customer Data Cloud 84

1.7 The Road Ahead 85

2 Sales and Service with SAP S/4HANA 87

2.1 Business Case 88

2.2 Order and Contract Management 90

2.2.1 Process Steps 91

2.2.2 Business Models 92

2.2.3 Product-as-a-Service 93

2.2.4 Business Networks and Order Channels 94

2.2.5 Order and Contract Management with SAP S/4HANA 96

2.3 Sales Planning and Performance Management 100

2.3.1 Incentive and Commission Management 101

2.3.2 Sales Forecasting 102

2.3.3 Sales Analytics 104

2.4 Billing and Revenue Management 105

2.4.1 Billing and Revenue Management Models 106

2.4.2 Solution Options 108

2.5 Customer Service 111

2.5.1 Customer Service Models 112

2.5.2 Solution Options 114

2.6 The Road Ahead 117

PART II Operations

3 Supply Chain Planning with SAP Integrated Business Planning 121

3.1 Business Case 123

3.2 Sales and Operations Planning 124

3.2.1 Challenges in Sales and Operations Planning 124

3.2.2 Demand Planning 127

3.2.3 Supply Review 129

3.2.4 Pre-Sales and Operations Planning Review 131

3.2.5 Executive Review 131

3.3 Demand Management ... 132

3.4 Inventory Management ... 133

3.4.1 Inventory Quantity ... 134

3.4.2 Inventory State ... 136

3.4.3 Inventory Location ... 137

3.5 Response and Supply Management ... 137

3.6 Supply Chain Analytics ... 139

3.7 The Road Ahead ... 140

4 Sourcing and Procurement with SAP S/4HANA and SAP Ariba 143

4.1 Business Case ... 144

4.2 SAP Portfolio Overview ... 146

4.2.1 SAP S/4HANA Enterprise Management ... 146

4.2.2 SAP Ariba ... 147

4.2.3 SAP Fieldglass ... 149

4.3 Sourcing ... 150

4.3.1 Reactive Sourcing ... 150

4.3.2 Tactical Sourcing ... 151

4.3.3 Strategic Sourcing ... 153

4.4 Purchasing ... 161

4.4.1 Purchase Request ... 162

4.4.2 Purchase ... 164

4.4.3 Acknowledgment and Shipping Notifications ... 164

4.4.4 Receiving ... 165

4.4.5 Invoicing ... 165

4.5 Services Procurement ... 167

4.5.1 Services Purchasing ... 168

4.5.2 Services Processing ... 169

4.6 The Road Ahead ... 170

5 Manufacturing with SAP S/4HANA 173

5.1 Business Case 174

5.2 SAP Portfolio Overview 176

5.3 Production Planning 178

5.3.1 Planning Strategies 179

5.3.2 Material Requirements Planning in SAP S/4HANA 182

5.4 Production Execution 184

5.5 Manufacturing Execution 186

5.5.1 SAP Manufacturing Execution 187

5.5.2 SAP Manufacturing Integration and Intelligence 187

5.5.3 SAP Plant Connectivity 189

5.6 Production Quality Management and Delivery 189

5.7 The Road Ahead 191

6 Supply Chain Management with SAP S/4HANA 193

6.1 Business Case 195

6.2 Inventory Management and Basic Warehouse Management 196

6.2.1 Goods Receipt and Goods Issue 197

6.2.2 Moving Stock between Locations 198

6.2.3 Cycle Counting and Physical Inventory 198

6.2.4 Stock Types 199

6.3 Extended Warehouse Management 203

6.4 Transportation Management 206

6.5 The Road Ahead 209

7 Asset Management with SAP S/4HANA 211

7.1 Business Case 212

7.2 Maintenance Management ... 213
7.2.1 Maintenance Strategies ... 213
7.2.2 SAP Portfolio for Asset Management ... 217
7.3 Asset Operations ... 228
7.3.1 SAP Asset Intelligence Network ... 228
7.3.2 SAP Asset Strategy and Performance Management ... 229
7.4 The Road Ahead ... 230

8 Research and Development with SAP S/4HANA 233

8.1 Business Case ... 235
8.2 Innovation Management ... 235
8.3 Product Lifecycle Costing ... 238
8.4 Portfolio and Project Management ... 241
8.5 Commercial Project Management ... 242
8.6 The Road Ahead ... 245

PART III Financials

9 Financial Accounting with SAP S/4HANA 249

9.1 Business Case ... 251
9.2 Financial Statements ... 252
9.2.1 Income Statement/Profit and Loss ... 253
9.2.2 Balance Sheet ... 254
9.2.3 Cash Flow Statement ... 257
9.3 General Ledger Accounting ... 258
9.3.1 Chart of Accounts ... 261
9.3.2 Journal Entries ... 262
9.3.3 SAP S/4HANA Finance ... 263

9.4 Financial Close 265
9.5 Receivables Management 268
9.6 Invoice Management and Accounts Payable 272
9.7 Asset Accounting 275
9.8 Real Estate Management 277
9.9 Financial Consolidation 278
9.10 Governance, Risk, and Compliance 282
9.11 Treasury Management 284
9.12 The Road Ahead 286

10 Management Accounting with SAP S/4HANA 287

10.1 Business Case 288
10.2 Cost Management 290
10.3 Planning and Control 293
10.4 Profitability Analysis 297
10.5 Project Accounting 300
10.6 The Road Ahead 303

PART IV Human Resources

11 Core Human Resource and Talent Management with SAP SuccessFactors 307

11.1 Business Case 308
11.2 Hire-to-Retire Process Overview 309
11.3 Core Human Resources and Payroll 312

11.4 Time and Attendance ... 317

11.5 Recruiting and Onboarding ... 319

11.5.1 Recruiting ... 320

11.5.2 Onboarding ... 322

11.6 Learning and Development ... 324

11.6.1 Learning ... 325

11.6.2 Succession and Development ... 326

11.7 Performance and Compensation ... 327

11.7.1 Performance and Goal Management ... 327

11.7.2 Compensation ... 329

11.8 Workforce Planning and Analytics ... 330

11.9 The Road Ahead ... 331

12 Contingent Workforce Management with SAP Fieldglass 333

12.1 Business Case ... 335

12.2 Simple Contingent Work ... 336

12.3 Complex Contingent Engagements ... 340

12.4 The Road Ahead ... 343

13 Travel and Expense Management with SAP Concur 345

13.1 Business Case ... 346

13.2 Expense ... 349

13.2.1 Making a Claim ... 350

13.2.2 Approving a Claim and Reimbursement ... 350

13.2.3 Additional Functionality for Concur Expense ... 351

13.3 Travel ... 352
13.3.1 Travel Management Companies ... 353
13.3.2 Additional Functionality for Concur Travel ... 355
13.4 Reporting ... 356
13.5 Monitoring ... 357
13.6 The Road Ahead ... 357

PART V Data

14 Database and Platform 361

14.1 Business Case ... 362
14.2 Architecture Overview ... 363
14.3 Database Technology ... 366
14.3.1 Database Services ... 368
14.3.2 Data Access ... 371
14.3.3 Analytics Processing ... 373
14.4 Application Platforms ... 375
14.4.1 SAP Cloud Platform Core Capabilities ... 378
14.4.2 SAP Leonardo ... 382
14.5 User Interface ... 383
14.5.1 SAP Fiori ... 384
14.5.2 Artificial Intelligence and User Interfaces ... 386
14.6 The Road Ahead ... 388

15 Data Warehouse 391

15.1 Business Case ... 392
15.2 Data Warehousing ... 394
15.2.1 SAP BusinessObjects and SAP Lumira ... 395
15.2.2 SAP Business Warehouse ... 397

15.2.3 SAP Business Warehouse on SAP HANA ... 400
15.2.4 SAP BW/4HANA ... 401
15.2.5 Embedded Analytics ... 405

15.3 Big Data ... 406

15.4 The Road Ahead ... 408

16 Analytics 411

16.1 Business Case ... 412

16.2 Business Intelligence ... 413
16.2.1 Traditional Business Intelligence ... 414
16.2.2 Modern Business Intelligence ... 415
16.2.3 Bimodal Business Intelligence ... 419

16.3 Enterprise Performance Management ... 427
16.3.1 SAP Business Planning and Consolidation ... 427
16.3.2 SAP Profitability and Performance Management ... 428

16.4 Predictive Analytics ... 429
16.4.1 Predictive Analytics Library ... 430
16.4.2 SAP Predictive Analytics ... 430

16.5 The Road Ahead ... 431

17 Enterprise Information Management 435

17.1 Business Case ... 436

17.2 Data Strategy ... 438

17.3 Data Governance ... 440

17.4 Data Quality and Remediation ... 445
17.4.1 Discover and Measure ... 447
17.4.2 Monitor and Improve ... 449

17.5 Data Migration ... 451
17.5.1 Data Migration Phases ... 452

17.5.2 SAP S/4HANA Migration Cockpit ... 455
17.5.3 SAP Data Services ... 456
17.5.4 SAP HANA Smart Data Integration ... 456
17.5.5 SAP HANA Smart Data Quality ... 457

17.6 The Road Ahead ... 458

PART VI Integration and Administration

18 Application Integration 463

18.1 Business Case ... 464
18.2 Cloud Integration ... 466
18.3 Process Orchestration ... 470
18.3.1 SAP Process Orchestration Architecture ... 471
18.3.2 SAP Process Integration ... 472
18.3.3 SAP Business Process Management ... 475
18.3.4 SAP Business Rules Management ... 477
18.4 API Management ... 479
18.5 Process Mining ... 481
18.6 Operational Process Intelligence ... 485
18.7 The Road Ahead ... 488

19 Administration 491

19.1 Business Case ... 492
19.2 Business Processes and Best Practices ... 493
19.3 Portfolio-to-Project ... 496
19.4 Requirement-to-Deploy ... 500

19.5 Request-to-Fulfill 505
19.6 Detect-to-Correct 506
19.7 The Road Ahead 511

Conclusion 513
The Authors 521
Index 523
Service Pages I
Legal Notes III

Preface

Welcome to the next generation of SAP!

This book comes from a recognition that the world of SAP applications and technology is evolving and has been doing so at a furious pace, leaving many customers (and consultants) unsure of the way forward for SAP and what a "next-generation" SAP landscape will look like in the future. We've written this book to take a step back and provide an overview of the SAP portfolio and where it's heading. By painting a picture of the next-generation SAP landscape and tying the new and enhanced products directly to discrete business processes, we have adopted a narrative rather than a technical tone to describe how SAP solutions can be used to support and enable your business in new ways.

To provide context to each topic, we've constructed a fictional business case that we reference throughout the book. In each chapter, we look at the way in which our fictional company has looked to adopt and use SAP applications and technology to enhance and support the business. This isn't intended to be a blueprint for your use of SAP, but more of an example of how SAP could be applied given the (admittedly fictional) constraints of an example company.

Who This Book Is For

This book is for anyone looking to gain an overview of the next-generation SAP portfolio, how it enables business functions, and how the various elements interlink with each other. Whether you are a customer looking to understand the road ahead, a consultant looking to broaden your knowledge, or a business leader embarking on a transformation program, this book will provide a starting point for you to jump into the world of SAP. For both design and necessity, this book provides a high-level view, and unlike other SAP PRESS publications, this isn't intended to be a comprehensive guide to each and every product.

How This Book Is Organized

We've laid out this book in six main parts with each part aligning to a set of interlinked business functions or related technical topics. Within each part, we've focused

individual chapters on specific business functions or technical topics and the related SAP applications and services that support them. To help frame each topic, each chapter follows a consistent structure, opening with a Business Case section that looks to bring each chapter to life and set some real world context for the topic. For a few chapters with a high number of interacting SAP solutions, an overview section is provided after the Business Case section. At the end of each chapter, we provide a Road Ahead section, where we provide our perspective on what may come next to give a look at what the future may look like for each area.

Within each section, you'll find the following series of text boxes:

- **Out with the Old**
  These text boxes highlight legacy technologies and old products/product names, to help you connect the modern landscape with traditional SAP offerings.
- **What's Right for You?**
  These text boxes help you make decisions within a varied solution portfolio that may impact your IT processes or priorities.
- **Digital Disrupter**
  These text boxes introduce new technologies (in particular those under the SAP Leonardo umbrella), and explain how they impact key business processes.

Structure

Given the broad scope of this book, it isn't necessary to read it sequentially; certain parts and chapters may be more pertinent or of more interest than others. So, if you have a particular interest in manufacturing or in how to manage a contingent workforce, you can start reading the relevant chapters without having gone through the others first. The book is broken into broad parts and then subdivided further into specific chapters, so now let's review what is covered within each part and chapter.

Part I: Customer Experience

We kick off the book by looking at how SAP can support businesses in their sales cycles and in delivering on customer experience goals. We start with a look at SAP C/4HANA and then how SAP S/4HANA supports the sales and service processes in the following chapters:

- **Chapter 1: Customer Experience with SAP C/4HANA**
  Traditional customer relationship management (CRM) has been usurped by a focus on the customer experience, with tools bringing in data from multiple channels to build a more complete picture not just of the customer but the journey and experience. This chapter will focus on SAP C/4HANA.
- **Chapter 2: Sales and Service with SAP S/4HANA**
  Chapter 2 deals with the processing of the sale from a legal and regulatory perspective and discusses billing and revenue recognition. The main product focus is SAP S/4HANA.

Part II: Operations

This section of the book addresses the operational aspects of your business, from supply chain, to manufacturing, and to research and development (R&D). We look at how next-generation SAP solutions can enable operational excellence in the following chapters:

- **Chapter 3: Supply Chain Planning with SAP Integrated Business Planning**
  Chapter 3 branches into supply chain planning to discuss how our case study organization preemptively planned the requisite supply to meet its expected demand. The main product focus is SAP Integrated Business Planning (SAP IBP).
- **Chapter 4: Sourcing and Procurement with SAP S/4HANA and SAP Ariba**
  This chapter looks at the procurement process, which acquires the materials necessary to supply a product. The product focus is split between SAP S/4HANA and SAP Ariba, so the chapter outlines what each solution offers and provides guidance on which solution makes sense based on the procurement focus of your business.
- **Chapter 5: Manufacturing with SAP S/4HANA**
  After materials are acquired, manufacturing must be planned. This chapter advances the case study from planning strategies, through production scheduling and quality management, to the completed, manufactured material. The main product focus is SAP S/4HANA, with mention of Manufacturing Execution Systems (MES) when appropriate.
- **Chapter 6: Supply Chain Management with SAP S/4HANA**
  Here we address the movement and storage of raw/component materials (Chapter 4) and manufactured materials (Chapter 5), including transportation, inventory management, and warehouse management. The main product focus is SAP S/4HANA Enterprise Management alongside SAP Extended Warehouse Management (SAP EWM) and SAP Transportation Management (SAP TM).

- **Chapter 7: Asset Management with SAP S/4HANA**
  Asset management is the process of operating, maintaining, upgrading, and destroying assets. This chapter examines asset management in our case study (e.g., a specific production machine) and by discussing alternative business models where maintenance of assets is of principle concern (e.g., power grids or gas distribution companies). This chapter also discusses the practical application of predictive capabilities. The main product focus is SAP S/4HANA, with mention of SAP Predictive Maintenance and Service and the SAP Asset Intelligence Network when appropriate.
- **Chapter 8: Research and Development with SAP S/4HANA**
  Part II closes on a detour into the development of our case study organization's product, covering innovation, SAP Product Lifecycle Costing, SAP Portfolio and Project Management, and SAP Commercial Project Management with SAP S/4HANA.

Part III: Financials

This section of the book focuses on the management and reporting of accounts within SAP S/4HANA. Understanding and managing the performance of a company is at the core of finance, and is therefore essential to running a successful enterprise. We dive into both aspects in the following chapters:

- **Chapter 9: Financial Accounting with SAP S/4HANA**
  All activity within a business eventually ends in financial processes. Here we explain how SAP S/4HANA supports the execution of these processes, as well as the production of reliable and timely financial statements.
- **Chapter 10: Management Accounting with SAP S/4HANA**
  Management accounting is concerned with the internal management of an organization, and in this chapter, we look at how this is achieved through SAP S/4HANA.

Part IV: Human Resources

People are key to any business, whether they are permanent employees or more flexible resources. This part of the book focuses on the human element of the business, with the following chapters covering core HR, contingent workforces, and the expenses of moving your people around:

- **Chapter 11: Core HR and Talent Management with SAP SuccessFactors**
  So far, the book has focused on logistical and financial resources. This chapter shifts attention to the case study organization's human capital and walks through the processes that maximize employee performance and align their efforts to the business's objectives. The main product focus is SAP SuccessFactors.
- **Chapter 12: Contingent Workforce Management with SAP Fieldglass**
  Organizations often contract in parts of the workforce from other vendors. This chapter examines a contingent workforce from both an HR perspective and a procurement perspective. The main product focus is SAP Fieldglass.
- **Chapter 13: Travel and Expense Management with SAP Concur**
  Employees travel across the globe on company business, so here we examine the business processes around travel expenses, requests, and reporting. The main product focus is SAP Concur.

Part V: Data

Data is key to any enterprise, so the following chapters in this section of the book explain where transactional and master data is persisted (the database), where data sets are consolidated (data warehouses), how the data is presented and queried (analytics), and finally how the data can be governed:

- **Chapter 14: Database and Platform**
  This chapter deals with two extremely important and interconnected topics: SAP HANA and SAP Cloud Platform (both can be platforms and/or databases). This chapter explains key SAP HANA concepts and the emerging role of SAP Cloud Platform within the scope of SAP S/4HANA.
- **Chapter 15: Data Warehouse**
  In the era of in-memory databases and big data, the role of data warehouses is changing. This chapter explains the evolution of SAP Business Warehouse (SAP BW on SAP HANA and SAP BW/4HANA) and the native capabilities of SAP HANA itself.
- **Chapter 16: Analytics**
  So far, this section has focused on where data is held, but in this chapter, we look at the use of this data to provide insight and intelligence into how the enterprise is performing. The chapter discusses SAP HANA Data Management Suite, SAP Analytics Cloud, SAP BusinessObjects, and SAP Business Planning and Consolidation (SAP BPC), with touchpoints around predictive analytics and other technologies.

- **Chapter 17: Enterprise Information Management**
  This chapter discusses a practical approach to enterprise information management (EIM), explaining how you can meet the ongoing challenge to ensure that data is complete, trustworthy, and relevant within your organization. We introduce SAP Master Data Governance (SAP MDG), SAP Information Steward, and SAP Data Services, and take a look at SAP HANA smart data integration and SAP HANA smart data quality.

Part VI: Integration and Administration

The final part of the book focuses on how to bring everything together, in terms of integrating your business processes, applications, services, and partners. We end by looking at how you can administer the planning, execution, and running of SAP applications within SAP Solution Manager.

- **Chapter 18: Application Integration**
  To facilitate a homogenous set of business processes, each organization must integrate data across different systems. Using the continuous case study, this chapter explains traditional integration (i.e., mapping and moving data), SAP API Management, and the orchestration of business processes across more than one system. The main product focus is SAP Process Orchestration and SAP Cloud Platform Integration, with mention of SAP API Management, SAP Process Mining by Celonis, and SAP Operational Process Intelligence.
- **Chapter 19: Administration**
  The case study has already discussed both the business processes and the SAP products that facilitate them. The final piece of the puzzle is to discuss how these processes and products are implemented, administrated, and monitored. SAP Solution Manager has evolved into an integral product for SAP customers; this chapter explores the strategy and practice of administering an SAP landscape with this tool.

Case Study

To explain this wide-ranging topic and endeavor to give context and tangible examples as we work through this book, here we'll outline the background for a fictional organization that will act as a case study that will be described and elaborated upon throughout this book. We anticipate (and hope!) that certain aspects of the case study

may resonate or sound eerily familiar to you, as the intent is to describe situations and challenges faced by organizations in the real world.

Let's introduce our fictitious organization: Bault Robotical. Bault Robotical is an organization that (unsurprisingly given the name) designs, manufactures, and distributes robots of all shapes and sizes. Its range of robots is wide, from simple mass-produced robotic vacuum cleaners right through to custom robots for Industrial and Intelligent Manufacturing Systems (I2MS) and Mobile and Autonomous Robotics Systems (MARS). Bault Robotical began in 2000 with the small-scale manufacture of rudimentary robot vacuum cleaning systems. In common with many startups, Bault Robotical was funded privately with funding being split between a remortgage of the founder's house and a local innovation grant. However, unlike many other startups, Bault Robotical flourished, and within two years, revenue had grown sufficiently to warrant the establishment of a dedicated manufacturing unit and the expansion of the back-office.

With the need to support its enterprise and provide the right level of systemization and processes, Bault Robotical installed SAP R/3 (4.6c) and SAP BW in 2006. SAP Customer Relationship Management (SAP CRM), SAP Supply Chain Management (SAP SCM), and SAP Supplier Relationship Management (SAP SRM) were implemented over the subsequent five years as the business continued to grow and its needs expanded. There are also a number of other "systems" in use, ranging from Microsoft Excel spreadsheets to Access databases and on to more complex solutions running on a whole range of database and application platforms, many of which only serve one particular team or capability.

This expansion of the landscape also saw the company install an SAP Enterprise Portal, with the ambition of making a single, central point of entry to its various systems. This had limited success and isn't consistently used across the business. Some of the mobile workforce (sales and engineering, primarily) require access to data and functions while away from the office, but they generally wait until they can connect via the normal SAP GUI, storing information and updates either on paper or in local spreadsheets and the like. Parts of procurement use a mixture of standard SAP SRM content and custom approval applications built and run in the SAP Enterprise Portal but only because they must. Much of the business uses an on-premise SharePoint solution for general storage and collaboration.

As the Bault Robotical business grew, so did its interaction with third parties throughout aspects of the business such as supply chain and engineering. The company

shares information with third parties and offers limited elements of system integration with some of its key partners, for example, in the areas of warehousing and logistics. The company also captures information from a large range of their recent products relating to usage and consumption of consumables; this information is sometimes used as part of designing new products but generally ends up collecting metaphorical dust in spreadsheets stored on Bault Robotical's network.

Bault Robotical is an organization that prides itself on its culture of innovation, which is partly warranted with the organization having successfully filed more than 5,000 patents in its history. However, in common with many organizations of its size and scope, it has organically grown throughout its life both in terms of its system landscape and its business processes, and innovation hasn't been applied to its systems in the way it's applied to its products.

As a result, Bault Robotical acknowledges that its business processes are far from ideal, that certain silos exist within the business, and that the data accuracy is far from perfect. In concert with this, Bault Robotical has a burning database platform and while the core ERP system was upgraded to SAP ERP in 2012, the company hasn't performed any upgrades to the subsequent Enhancement Packs (EHP); instead, it has deployed numerous enhancements and new features through the heavy use of custom code and objects.

This combination of older software, burning platform, and extensive customizations is recognized as limiting Bault Robotical's ability to innovate internally, with the IT department feeling trapped and unable to deliver the functions and capabilities requested by the business within a sensible time frame and budget. Maintaining the current landscape has become quite reactive, applying software patches and fixing reported bugs/issues as needed, rather than delivering new capabilities to the business.

As a result, the relationship between IT and the rest of the business has become strained and not as productive as it could be. This is especially prevalent when business users attempt to access data and information across the SAP landscape to drive out insights or support decision-making. More often than not, the users will extract various pieces of information and then consolidate them into something usable via many spreadsheets.

Having laid out some history and context here, we'll continue to build upon this case study throughout the book, first outlining the need for digital transformation in our

introduction and then subsequently detailing the business needs and potential solutions within each chapter's area of focus. While we've tried to keep the case study as consistent as possible, we have had to occasionally deviate from the main thread to adequately illustrate the business drivers for a particular solution or approach.

Acknowledgments

Any book that covers the bulk of the SAP portfolio, dives into new technologies, and examines the road ahead for SAP can only be possible with the combined efforts of a large number of people. We have been incredibly lucky to have support and input from some true experts, who have given their time and knowledge freely to make this book possible. Our genuine and deepest thanks to both our colleagues within AgilityWorks and beyond, including Tom Devonald, Jon Spooner, Nick Davies, Uche Nnene, Mark Smith, Sameer Shah, James Clough, James Rothwell, Jon Holdcroft, Krishneel Goundar, Mike Colbourn, Antonio Morais, Sriram Nandula, Alan Hunt, James Blackburn, Manu Singhal, Munthir Wagieallah, Nilesh Hatkar, Giulio Gatto, Ashim Nayyar, Tushank Thakur, Gavin Rugg, John Heald, Stan Hodgson, David Palhota, Tony Rust, Pepe Uppal, Sunny Patel, and Nick Bewers.

We would also like to offer our special thanks to Liz Jones for carousing and cajoling us into action, and to Emily Nicholls and Megan Fuerst at Rheinwerk Publishing for their seemingly endless patience.

The authors would also like to extend their individual thanks.

On a personal level, Matt Riches would like to thank his kids Livvie, Chloe, and Harry for always offering much better alternatives to sitting down and writing this book. He would also like to thank his parents, who (as always) supported this endeavor. His last, and biggest, thank you is reserved for his amazing wife Ellie, without whom this book and so much more would never have turned out so well!

On a professional level, this book is the result of the hard work of many of Matt's colleagues at AgilityWorks. However, Matt can honestly say that this book would not have happened without the enormous effort (and knowledge) of Uche Nnene – thanks Uche!

Ben Robinson would like to say a big thank-you to Kirsten for putting up with more disruption, late nights, and interrupted weekends than usual.

Gareth Ryan would first like to thank the two people who have become a massive part of his life, mostly due to their careers in and around SAP for the past twenty years. He

thanks Phil and Dr. Shinks for the fun and friendship—here's to another twenty years of PEC and Flop-Flip code.

Most importantly, Gareth would like to thank his wife Kate and children Harry and Isabelle, who have supported him as always, and guarantee that he's always got something to smile about.

Ian Vincent would like to offer his heartfelt thanks and gratitude to Claire for putting up with him vanishing for hours on end to work on this book, and to Joseph and Toby for offering a much-needed excuse to take a break (and for not drawing on any of Daddy's notes).

Conclusion

This book will give you a broad view of the next-generation SAP portfolio, how it interrelates, and where it's heading. It will serve as a foundation for further evaluation and investigation into SAP implementations, as well as provide an indication of where you can take your existing SAP implementations to in the future. From here, you can dive into specific training and resources from SAP, as well as the extensive back catalog of books from SAP PRESS.

Introduction

This chapter introduces what digital transformation means to an SAP-centric business, before moving on to introduce some of the key products that serve as the functional baseline for this book.

In this book, we'll introduce the "new" world of SAP solutions and technologies for those who want to understand both the functionality offered and the real-world business processes that they support. For those familiar with SAP, the world is changing and changing fast, with a new business suite (SAP S/4HANA) now launched, SAP ERP being retired, the SAP HANA platform becoming an integral element of the solution landscape, and acquisitions (e.g., Ariba, Concur, SuccessFactors, and Fieldglass) becoming central elements in the new portfolio. SAP has changed because technology has fundamentally redefined what is possible from a business process perspective. Not since the Industrial Revolution has technology pushed the business agenda in the way it's doing today, creating new business models and slaying megacorporations who aren't able to adapt or keep up. Therefore, in this book, we'll also discuss emerging technology, such as the Internet of Things (IoT), blockchain, machine learning, and artificial intelligence (AI), together with a number of other applications and services that, from an SAP perspective, fall under the umbrella of SAP Leonardo.

Within this chapter, we'll seek to introduce SAP's new portfolio while also centering it within the context of the challenges facing a modern business. We'll begin by discussing digital transformation and considering what connotations this somewhat overused term has for today's businesses. In doing so, we'll look at how modern technology has both the ability to disrupt long-established business models while also providing organizations with the ability to optimize and revolutionize existing models. After discussing the challenges, we'll move on to introduce SAP's next-generation portfolio and try to set some foundational understanding that will be expanded upon throughout the rest of this book.

What Is Digital Transformation?

Considering how the term "digital transformation" has become somewhat of a buzzword in recent years, anyone reading this could be forgiven for thinking that the term comes with a universally accepted definition. The truth is altogether more vague, however, and while a huge amount has been written about digital transformation and specifically the dire consequences for those organizations who try to ignore it, a simple definition remains tantalizingly out of reach. In fact, rather than a single accepted definition, even a cursory glance into this topic uncovers little more than a series of sound bites, slogans, and buzzwords.

After attempting to break down the topic (a mission involving a multitude of articles and papers, a thesaurus, and a strong coffee), we propose the following simple definition of digital transformation that we'll use for the remainder of this book:

> *Digital transformation is the realignment of business capabilities with today's technology.*

As soon as you mention digital transformation to some, you may hear something along the lines of, "digital transformation is just the latest badge for what a business has been doing for years!" In many ways, this view has merit, however, the reason digital transformation is such an important topic today relates to the fact that technology has gone beyond the point where it merely supports and streamlines existing business processes into areas where it creates and shapes new business models entirely. To illustrate this point, take the introduction of the personal computer as a replacement for the typewriter. In technological terms, it was huge moving from mechanical (or electromechanical if you were lucky!) machines that transmitted ink to paper via a ribbon to microprocessor-driven devices that allowed you to delete, save, and make multiple copies of documents. Now while from a technological standpoint this was a big deal, from an overall economy and business perspective, it was a fairly small deal. This is because while it streamlined an existing process and made record keeping more efficient and effective, it didn't fundamentally alter what a business did. In short, it made the existing business model more efficient, but it didn't disrupt the model itself.

Now compare that to the technology of today. Technological capability has exploded and infiltrated areas that could not possibly have been imagined even a decade ago. So rapid has the evolution of technology been that, in many cases, it has outstripped the ability of organizations to keep up and in certain well-documented examples has

actually fractured the bedrock of traditional business models, causing fault lines to be created under the most illustrious and established of organizations.

We'll therefore begin this chapter by defining two specific sides of digital transformation: digital disruption and digital optimization. These two aren't technological classifications but rather what the application of this technology means for individual businesses and existing business model. We'll begin by discussing the most "in your face" element of digital transformation—digital disruption.

Digital Disruption

Digital disruption is the poster child for digital transformation and is the aspect that gets the most attention; it's the Uber, Netflix, and AirBnB—the game changer. Essentially, this category of digital transformation has the power to topple monopolies and slay megacorporations simply by using technology to create new business models that are so profoundly desirable for customers that the long-established ways of doing things are forgotten in a heartbeat. In effect, a new default model is created for an entire industry overnight, and those organizations that have either ushered in the change or that can react to the change, win, and win big. On the other hand, those organizations that can't or won't, regardless of size, legacy, or standing, face the prospect of becoming obsolete.

Let's explore this concept through a real-life example: Blockbuster and the video rental industry. First, consider that Blockbuster began life as a very disruptive company and introduced many new business models into what was a stagnant industry. For example, Blockbuster was the first organization to overcome the fractured video store industry of the past, populated by local owners with no power or pull over the large film studios. Blockbuster managed to provide its customers with lower rental fees by securing volume discounts with large studios and passing these savings onto consumers. The strategy worked well by providing rental stores with a huge range of choice and competitive prices, Blockbuster effectively secured the first monopoly within the video rental industry.

The problem for Blockbuster was that despite optimizing the existing video rental business model, the model itself was hardly a flawless customer experience, from making customers trek to the stores to pick a movie to the threat of late fees. Where Blockbuster lost was by focusing on optimizing the existing flawed model and concentrating on beating or acquiring its similar competition.

Now many people will cite the emergence of the Internet and the ability of consumers to stream movies instantly as the catalyst to Blockbuster's downfall. However, the truth is that Blockbuster was in decline long before the advent of the downloadable or streamable movie. In fact, while digital technology played a part (the ability to order movies from the Internet), the real disruption in the model came from far more mundane channels, namely that first movies were mailed directly to the consumer, and secondly the removal of late fees. Of course, the mailable-based business model itself was rapidly superseded by the ability to stream unlimited movies on demand for a flat monthly fee.

Now a new business model is only disruptive if existing companies fail or fundamentally struggle to adapt to it. For example, if Blockbuster could have switched its business model to fit the evolving commercial realities, then it would not be viewed as the giant slain by digital transformation and, more specifically, Netflix.

In fact, the antidote to digital disruption is our second classification of digital transformation—digital optimization.

Digital Optimization

It's true that some organizations and some industries are at less imminent risk of disruption, however, when considering why Blockbuster failed and others have thrived, we can see a common theme: organization ambition and agility. The truth is that technology can only ever provide the capacity to transform; it needs to be accompanied by the corresponding business drive, ambition, and ability to transform. Without this, all the digital technology in the world will amount to nothing. To highlight the importance of this, let's consider an organization that on the face of it should be ripe for disruption: Burberry.

Established in 1856, Burberry is a luxury brand business that had been in existence 129 years before the incorporation of Blockbuster. As an industry, luxury clothing and retail had been hit hard by changes in customer buying habits with many household names disappearing from main street. The rudimentary act of a customer buying from a seller has been significantly disrupted by digital technology with the rise of the Internet, mobile commerce, and peer-to-peer referrals to name but a few. The stark reality for luxury brands such as Burberry is that the equity in the brand that took decades to build doesn't naturally translate well to online.

Burberry has bucked the industry trend, however, and has actually thrived in this challenging environment after being one of the earliest organizations in this sector

to consciously adopt a proactive approach to digital. After an announcement in 2006 that it wanted to become a fully digital business, it actively embraced all aspects of digital. Burberry launched its own social media platform in 2009 and has been a pioneer in the development of new social media buying channels such as Snapchat, Periscope, Instagram video ads, and Twitter buy buttons. In 2014, Burberry upgraded its mobile site, which resulted in a tripling of its mobile revenue.

What Burberry did was optimize what it did and what it had done for more than 150 years—sell clothing. It neither changed what it did nor did it pioneer a fundamentally disruptive way of doing it. The success for Burberry, however, came more from the ability of the organization to commit to refocusing its entire strategy around the opportunities that new technology afforded. Whereas others in the industry dipped their toe in, Burberry jumped in head first.

Digital Transformation Business Case

In common with most organizations around the world, digital transformation had been a topic that slowly started to ascend the agenda of board meetings at our fictitious business case, Bault Robotical. The principle advocate was the chief information officer (CIO) who had been raising concerns about the supportability of various key hardware elements and applications that underpin key business processes. A server refresh was required, and the organization's SAP ERP system was various versions and upgrades behind the latest. In addition, ever present at the back of the CIO's mind was the knowledge that SAP had earmarked 2025 as the end of support for the SAP ERP product.

In concert with this, there was also a tacit understanding that the business would need to reduce costs and perform a degree of surgery on its business model within the next five years. Therefore, after almost two years of discussion, the board at Bault Robotical decided to sanction an investigation to determine what a digital transformation would look like and to address questions pertaining to potential cost and effort.

The first focus of the project team was the destination.

Begin with the End

The first thing that any organization serious about transforming itself needs to do is to define the vision of what the organization will look like after the program of work

has been completed. Now this may seem a banal point, but many transformations fail purely down to the fact that the vision and road map of how to attain that vision aren't fully fleshed out at the inception of the program.

The first job of the transformation team at Bault Robotical was therefore to understand what the company wanted and needed to look like at the end of the transformation, beyond the implementation of a new business suite or IT solution. At first, the business struggled to answer this fundamental question and answered it with buzzwords and platitudes. However, without this clarity of vision, how could the transformation team ensure that the business was to be transformed in the correct way?

Asking questions that wouldn't normally be asked in a typical SAP ERP implementation is an indicator that you're heading along the right track.

To finally define the vision, a meeting was scheduled with the senior executive with the specific goal of defining the vision for the program at Bault Robotical. This meeting captured the imagination of the senior management team and served as a two-way education session where the senior management team got to understand the capabilities of the technology, and the transformation team got to understand in more detail the key challenges and aspirations of the business.

Working with the CEO, a vision of the program at Bault Robotical was finalized:

- Due to a predicted revenue challenge, the business must reduce OPEX by £10 million year on year. This challenge begins in 24 months' time.
- The future strategy on the business is based on acquisition, and the business must be able to accommodate this with a minimum degree of disruption.
- The business wants to move to providing services rather than simply sales in certain areas. The ability to quickly adopt this business model plus other yet to be determined business models highlights a need for our future business to be agile and reactive.

Plan into Action

With the vision set, the next stage was to define how the vision could be realized. The following are details of some of the strategies that were defined in response to each vision area (other identified strategies are discussed throughout individual chapters of this book):

- **Reduce cost base**
  After diligent research, Bault Robotical found that a significant proportion of cost reduction would need to come from redundancies. This prompted the CEO to organize a series of "town hall" meetings with the business to explain both the challenge and the need for cost reduction. Emphasis was placed on complete cost reduction, but the CEO also didn't flinch when discussing the possibility of job losses. Importantly, the program of digital transformation was introduced as the business's strategic vehicle results, and all employees were invited to help shape the transformation.

  Understanding how and where roles could be removed without a degrading of business function was of paramount importance. The strategy identified key areas where it was felt that headcount could be reduced without impinging on the capability of the business:

  - **Linking the data capture directly to the back-office**
    The team identified that a significant degree of duplicate data entry within the organization occurred particularly when data was captured from the field. For example, data was previously passed back to office-based staff for entry into SAP. The organization has identified that being able to capture information that flowed directly into SAP at the source would both provide the opportunity for headcount reduction and should provide better information as an added benefit.
  - **Cost saving in the supply chain**
    The management at Bault Robotical also targeted the supply chain as an area of potential cost savings. It was felt that the company was particularity deficient in the area of supply chain planning, meaning that significant cost was incurred in both excess stock and, conversely, not having enough of the correct stock. To address this problem, it was decided that as part of the transformation the organization would instigate a formal monthly sales and operations planning (S&OP) process.

- **Accommodate acquisition**
  Currently, as may be guessed from both the age of the system and the organic growth the business has gone through in the past decade, the business processes are neither standard nor common between divisions or business units. This has been identified as an obstacle for the future integration of other companies. The strategy to overcome this is the adoption of standard processes across all back-office functions ideally based around SAP Best Practices, but as a minimum based

on standard delivered functionality contained within the system (i.e., no coding allowed!). SAP Best Practices content will be discussed further throughout this book.

- **Business agility and adoption of innovation**
  In common with the preceding strategy, the team decided that adopting standard processes throughout all back-end functions of Bault Robotical should provide a robust foundation onto which innovations can be built. Conceptually, the team segregated plans for the back-office (or core), which was to remain standard, and the extensibility layer, into which innovations new services or additions to the back-office could be quickly adopted. The SAP products that were identified to support this approach were SAP S/4HANA Enterprise Management for the core and SAP Cloud Platform for the extensibility layer; both products are discussed in more detail throughout the remainder of this book.
- **Transforming into a B2C business**
  Supporting this vision, the team decided that together with consolidating the backend processes, effort should also be spent looking at how this vision affects the design of the core together with understanding how the desire to move to a B2C model affects both the structure of the current organization and the proposed technological solution.

Having defined the vision and the strategies to achieve it, the next stage is to define the rules that will ensure that the program ultimately delivers the vision for the organization. This may seem like a simple step, but unless cast iron rules are defined, institutionalized, and protected, programs have the habit of degrading one decision at a time. A key distinction to make is between aspirations and rules. Aspirations are likely to wither and die during the winter of implementation. Rules, on the other hand, are more hardy; once institutionalized, they become set in stone and actually shape and guide the project. To illustrate what I mean, consider the rules that Bault Robotical ultimately imposed to ensure that the vision statement was achieved.

Bault Robotical wanting to implement standard processes is clearly an aspiration. Instead, they went one step further and created a team called the standardization committee, which was (and still is) made up of the CEO, head of compliance, and the CIO (who also doubles as the program sponsor). The standardization committee already outlined the terms under which deviation from standard process are allowed:

- Where SAP standard processes don't meet statutory responsibilities
- Where SAP standard processes don't meet regulatory responsibilities
- Where SAP standard process don't meet safety requirements of Bault Robotical
- Exceptional circumstances where the above rules don't apply but which are deemed to have a material impact in the efficient running of Bault Robotical

With this plan in mind, Bault Robotical began to assess its various business processes, identify challenges and goals, and examine the SAP solutions that can help achieve its goals. We'll follow along with Bault Robotical on this journey throughout this book.

Learning to Read the SAP Landscape

Before we begin to look at the next-generation SAP portfolio, it makes sense to have a brief recap of the roots and pedigree of its legacy suite of applications. This is particularly relevant because at the time of writing (fall 2018), far more organizations use this legacy suite than have moved to the new SAP S/4HANA-centric environment.

However, from 2025, SAP will no longer provide mainstream support for SAP ERP. SAP ERP (the product and the process it supports share a name) will be the last incarnation of the R/3 product, which is itself the latest in a series of SAP ERP products whose genealogy stretches back to 1971 and the release of SAP R1.

Therefore, before we delve into the new SAP portfolio, we should also consider why SAP is discontinuing SAP ERP and replacing it with SAP S/4HANA.

The functionality required for today's digital enterprise has grown exponentially beyond the boundaries of internal knowledge and fundamentally shifted to the acquisition of knowledge interpreted from everywhere—all data channels, including data from business networks to sources as diverse as IoT and Twitter. This poses a significant challenge to a traditional SAP ERP system.

Many businesses have embraced either SAP or non-SAP bolt-on systems, often through a software-as-a-service model (SaaS) in an attempt to keep pace with the growing opportunities digitalization of the business world brings. While many of these solutions provide an undoubted step forward in terms of levels of data collaboration, they can, in reality, go little further than creating "digital swans" who while

seemingly embracing the digital message (particular in dealings with customers) are, in reality, falling short of the goal.

Conceptually, data flows like water through a system. Where a pipe within the system is of sufficient size, the water flows freely; however, the speed of the water and thus the potential of the entire system is dictated by the flow of water through the narrowest point. Legacy ERP systems such as the SAP ERP products of the previous four decades were never intended, nor are technologically able, to deal with the volume and immediacy of data generated by today's digital economy. Even if it hasn't happened yet, it will inevitably become a company's digital bottleneck, hindering the agility of the company and providing a barrier to expansion into new markets.

Here enters next-generation SAP technologies, particularly SAP S/4HANA and SAP S/4HANA Cloud. In the following sections, we'll discuss the basics of SAP's new approach, from IT systems to the cloud.

IT Systems

Any book that seeks to introduce SAP's next-generation portfolio will at some point have to discuss SAP HANA. While this is a topic that will be discussed at length in Chapter 14, the SAP HANA platform is the technical foundation upon which the next-generation SAP Portfolio is built. For the technical reader, we should mention that at its core is a fully in-memory, columnar-store database engine that enables the combination of online transactional processing (OLTP) and online analytical processing (OLAP). For the nontechnical, we'll simply say it enables things that weren't possible before and point to the simple evolution of the SAP Business Warehouse (SAP BW) solution as a case in point.

For many organizations, SAP BW was, and remains, integral for a company to function because it provides key operational reporting functionality that organizations need to make strategic decisions. However, SAP BW has never been a good fit for operational reporting as generally SAP BW provides aggregations of data that have been transformed based on a predefined intelligent design. The reason that SAP BW has become such a staple of the SAP-centric organization is simple: legacy SAP ERP didn't have the technical capabilities to produce the operational reporting required of most businesses, so SAP BW evolved to fill the gap. However, SAP HANA has now removed this technical impediment in many situations. Whereas previously complex calculations and reports were too much for the legacy relational database

technically, now they aren't when sitting atop the SAP HANA database. Data can be processed at the source, on transactional, not aggregated, data.

Unlike any legacy products, the SAP S/4HANA digital core (or SAP S/4HANA Enterprise Management) has been redesigned specifically to interact with the backend SAP HANA platform. SAP S/4HANA means that the platform and application are indivisible, and the adopters of the SAP S/4HANA application must also adopt the SAP HANA platform. This intertwining of the application layer with the database layer is a significant change for SAP as all previous iterations of the SAP ERP product have been database-agnostic with the SAP ERP product consisting only of an application layer that was capable of running on multiple databases from multiple vendors.

This marriage between database and application means that SAP S/4HANA can deliver exponential improvements in terms and speed (by a factor of 10–1000x over traditional relational databases). While this technological advancement is impressive in itself, it's what it now facilitates in terms of next-generation functionality that truly distinguishes it from SAP legacy ERP products.

SAP Business Suite versus SAP S/4HANA

As described, SAP S/4HANA is the umbrella name given to an entire suite of SAP's next-generation applications. The term is often used incorrectly with many people assuming that SAP S/4HANA is the name given to the successor to SAP ERP. In reality, and as outlined next, SAP S/4HANA covers far more than the replacement of SAP ERP with that suite (SAP S/4HANA Enterprise Management) being only one of three distinct solution areas.

Rather than taking an application-based approach, SAP S/4HANA is arranged around 10 lines of business (LoBs), with one or more core applications providing the total solution scope. For example, in the case of the sourcing and procurement LoB, the complete functionality set is distributed through SAP S/4HANA Enterprise Management, SAP Ariba, SAP Fieldglass, and SAP Concur.

To help logically split each line of business into a product, SAP has segmented each LoB into the following three sections:

- **SAP S/4HANA Enterprise Management**
  Also known as the digital core, conceptually, SAP S/4HANA Enterprise Management can be thought of as the successor to SAP R/3 and contains the functionality

commonly associated with the traditional SAP ERP modules of Material Management (MM), Production Planning (PP), Sales and Distribution (SD), Finance (FI), Management Accounting (CO), and so on. Unlike previous versions of the ERP software (R1–SAP ERP), SAP S/4HANA is available both as a traditional on-premise version and as a SaaS-based public cloud option called SAP S/4HANA Cloud. SAP S/4HANA Cloud is a streamlined SaaS version of SAP S/4HANA and features a quarterly mandatory update cycle. We'll discuss this further in the next section.

- **SAP S/4HANA products**
  SAP S/4HANA products provide set of additional functionality that is licensed separately to SAP S/4HANA Enterprise Management but which extends the functionality of the core. Examples include SAP Extended Warehouse Management (SAP EWM), SAP Multiresource Scheduling, and SAP Portfolio and Project Management. Products such as SAP EWM and SAP Multiresource Scheduling have already been embedded within SAP S/4HANA while the rest of the products will become embedded in future releases. Embedded simply means that while this functionality used to be contained in a separate system, it now has been migrated into the single SAP S/4HANA system and works off the same data model.

  SAP S/4HANA products are also starting to appear that replace functionality that currently exists in SAP products that aren't seen as strategic. For example, advanced available-to-promise (AATP) functionality that once only existed in SAP Advanced Planning and Optimization (SAP APO) now appears within the SAP S/4HANA product. It's expected that the product area will continue to flex in functionality as legacy SAP applications are retired.

- **SAP S/4HANA suite**
  The SAP S/4HANA suite contains the cloud acquisitions of SAP Ariba, SAP Fieldglass, SAP Concur, SAP Hybris, and SAP SuccessFactors. These are all established SaaS products in their own right that SAP has acquired to extend the reach and functionality of its offerings. Crucially, they strengthen SAP's position in terms of business networks and also extend the scope and range of SAP functionality beyond the traditional core. We'll discuss SAP's cloud approach further in the next section.

Cloud versus On-Premise

The topic of cloud vs. on-premise could fill a book in its own right, so we'll only give it cursory attention here. Basically, on premise means that software is installed locally on a company's own computers and servers. Conversely, cloud consists of physical

storage sometimes spanning several physical locations that is typically owned and managed by a third party, such as a hosting company. Using the cloud means that rather than purchasing expensive IT equipment, organizations can potentially reduce cost and increase service by leveraging hosted services. The cloud has also facilitated a new way of selling software and platform services. While these specific concepts will be discussed at length later in this book, they are so central to many of the products in SAP's new solution portfolio that we'll establish them upfront:

- **Software-as-a-service (SaaS)**
  SaaS is an application that an organization "rents," and, as opposed to traditional applications, the organization using the software doesn't install the software, it simply consumes it. SaaS products such as SAP Ariba, SAP Concur, and SAP S/4HANA Cloud come with a much smaller administrative and maintenance overhead due to the fact that the software is maintained and enhanced by the software provider. The ability therefore for the organization using the application to add and make changes to the application code is significantly curtailed within SaaS products. This means that in a modern implementation of a SaaS solution, the business is obliged to change its business processes to fit the product rather than the other way around.
- **Platform-as-a-service (PaaS)**
  Rather than renting an application, you're effectively renting a platform, on which you can do many things such as develop applications, integrate systems, visualize data, and a wide range of other activities. From an SAP portfolio perspective, SAP Cloud Platform is the key PaaS offering and can be thought of as the glue between the next-generation SAP portfolio. SAP Cloud Platform is briefly outlined next and in greater detail in Chapter 14.

SAP S/4HANA versus SAP S/4HANA Cloud

Until SAP S/4HANA, SAP only provided one conceptual way of consuming its SAP ERP functionality: on-premise. This meant that you bought licenses for software that was then installed locally, and which you could freely modify and tailor to your own purposes. As most organizations can attest, code could be changed, transactions amended, and processes rerouted all because the code itself belonged to the company, and they had the responsibility of keeping it aligned and updated with the company who had implemented it.

However, with the advent of SAP S/4HANA, SAP has introduced both a traditional on-premise version but also SAP S/4HANA Cloud, which is a SaaS version of SAP

S/4HANA. Now the first thing to address is the name—Cloud—as this is a common cause of confusion and misunderstanding.

Per Figure 1, SAP S/4HANA Enterprise Management can be deployed in three key ways:

- **On-premise**
  On-premise SAP S/4HANA is effectively a solution that the customer owns and operates. They can change code, and they are responsible for upgrades and for the stability of the system. It also contains a wider set of functionality that has been deliberately turned off in SAP S/4HANA cloud.
- **Private cloud**
  This is the deployment of the on-premise version of SAP S/4HANA onto a private cloud.
- **Public cloud**
  This is an SAP S/4HANA Cloud deployment.

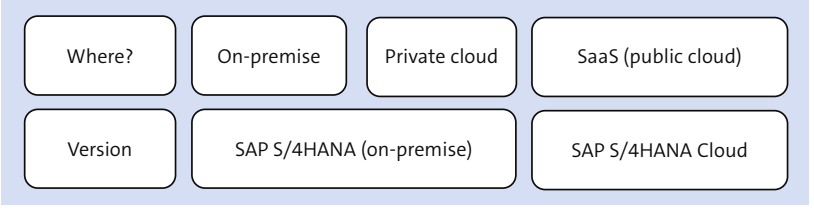

Figure 1 SAP S/4HANA Versions and Cloud Deployment Options

Cloud-based SaaS is potentially the Netflix to SAP's Blockbuster, that is, the disruption that causes SAP to lose its status as one of the most popular ERP brands. However, unlike Blockbuster and akin to the actions of Burberry, SAP is attempting to refocus its entire organization toward the new digital opportunity. Currently, it's clear that SAP believes the future of ERP is in the cloud, and it's equally apparent that SAP has bet the farm on becoming a major player in SaaS-based ERP. To this end, the lion's share of SAP development and marketing budgets have been and continue to be focused on establishing SAP S/4HANA Cloud as a viable alternative to both SaaS-based SAP ERP rivals, such as NetSuite, and to its own on-premise software.

SAP S/4HANA Cloud basically contains a streamlined subset of the functionality available within the on-premise version of SAP S/4HANA; however, unlike the on-premise version, it has four major quarterly releases a year (the on-premise version has one major release a year). SAP advocates a cloud-first approach, meaning that

new functionality is available within SAP S/4HANA Cloud before SAP S/4HANA. SAP S/4HANA Cloud also contains wizards to accelerate the implementation and adoption.

To illustrate the direction, in 2017, Gartner suggested that by 2020, a minimum of 35% of product-centric ERP deployments in large enterprises will be based on a SaaS model that is integrated to on-premise Manufacturing Execution Systems (MES). Furthermore, Gartner suggested that within the next eight years, at least 50% of large enterprises will successfully implement a "flip" SaaS strategy and will be running their core ERP in the cloud.

Gartner aside, however, the rate of SAP S/4HANA Cloud adoption certainly within larger organizations isn't yet reflecting this adoption. This is underpinned by two key motivating factors. First, as a SaaS model, the level to which the processes can be "bent" to fit the desires of the business is dramatically reduced, meaning that prior to adoption of SAP S/4HANA Cloud, the organization must be confident that its business processes can be effectively represented inside a deliberately restrictive model. Second, is to do with maturity and reference ability—at the moment, many organizations are waiting for more live instances of SAP S/4HANA Cloud to prove that this new model is viable before themselves taking the leap.

SAP Cloud Platform

SAP's PaaS solution is SAP Cloud Platform and is a topic that features heavily in Chapter 14. Put (very) simply, SAP Cloud Platform provides the agile layer that sits around the stable SAP S/4HANA core and that provides both extensibility and effective management of complex landscapes that contain both SAP and non-SAP products. SAP Cloud Platform provides the following functionality (note this is far from an exhaustive list):

- Extensions to standard SAP solutions for both on-premise and cloud applications
- Ground-up, custom applications that can make use of mobile and offline capabilities
- End-to-end process improvement and orchestration across the landscape, including SAP Cloud Platform Integration, which provides the default integration to the next generation of SAP suite products of former acquisitions, including SAP SuccessFactors, SAP Ariba, and SAP Concur
- Agile data marts where data can be combined in the absence of a full data warehouse

- The foundation for longer term SAP Leonardo scenarios such as IoT, machine learning, and blockchain

Digital Disrupter

SAP Leonardo encompasses multiple technologies, services, and applications that can all be labeled as innovative. This includes topics such as the IoT, machine learning, blockchain, analytics, AI, and big data. Together with these technologies, the SAP Leonardo portfolio includes specific methodologies such as design thinking and data intelligence tools, benchmarking, and more.

SAP Leonardo will be discussed in many forms throughout this book and signals a clear intention by SAP to expand its reach from its traditional confines into emerging areas of technology.

In the coming chapters, we'll delve into the specific business processes and SAP products that together represent a modern enterprise. We'll endeavor to shed light on the role and responsibility of various SAP products and technologies and where appropriate delve into the functionality that they afford to a business. The scope of this book is wide, but we'll attempt to approach each chapter from a consistent "what it is" vantage point rather than a "how to do it" perspective.

PART I

Customer Experience

Chapter 1

Customer Experience with SAP C/4HANA

We'll begin our journey through the modern SAP world with a topic that is increasingly at the epicenter of the business world: the customer. SAP has been developing and acquiring customer experience (CX) software since 1999, so although many consider this a new area, it's a well-established part of SAP's product suite.

Improving customer experience (CX) is now a strategic objective for many of the world's largest and most successful firms. In this chapter, we'll explore the factors that are compelling firms to rethink their customer strategies, how they are approaching this change, and the role that SAP can play in supporting this.

CX refers to the feelings invoked in customers through their interactions with a company, its people, services, products, and brands. Companies that can deliver consistently positive and valuable experiences to their customers are winning in today's marketplaces.

The role of technology recently in developing and advancing CX has been profound; a new generation of customer relationship management (CRM) applications fueled on huge volumes of data and harnessing digital channels and technologies is helping firms to understand, serve, and interact with their customers more effectively than ever. This marks a step-change from first-generation transactional CRM systems, which brought order and structure to customer data and processes but often did little to actively improve CX.

What's Right for You?

As we explore the topic of CX, we'll draw distinctions between business-to-consumer (B2C) firms and business-to-business (B2B) firms because their challenges, requirements, and outlooks are different. B2C businesses are selling to private individuals often at significant scale, requiring a different business model, structure, data, processes, and technologies than their B2B counterparts.

In this chapter, we'll cover the SAP C/4HANA suite. SAP has made no secret of its intention to be a leading player in the CX software marketplace and continues to back this up with acquisitions alongside significant internal research and development. The SAP C/4HANA product suite includes sales, service, marketing, commerce, contact center, and industry-specific applications, delivered as a series of separate but integrated products.

Out with the Old

SAP's CX product suite has been through multiple evolutions and rebrandings. Let's take a quick look at these now to clear up any misunderstanding.

SAP Customer Relationship Management (SAP CRM) was SAP's first specialist CX software suite, available as an on-premise solution only. This suite included Sales, Service, Marketing, Contact Center, Mobile, and Commerce modules.

As SAP shifted to a cloud-first strategy, it acquired Hybris in 2013 and quickly saw an opportunity to use Hybris as the brand name for their entire CX suite. The Hybris portfolio was a mixture of organically developed and acquired CX applications—some of which were on premise and some of which were cloud only.

In 2018, SAP launched SAP C/4HANA, a cloud-first product suite that includes many of the applications previously available under the Hybris brand. For certain industry-specific requirements, SAP still markets and sells SAP CRM as an on-premise option, but SAP C/4HANA is its primary CX portfolio.

SAP C/4HANA is made up of five main cloud solutions: SAP Sales Cloud, SAP Service Cloud, SAP Marketing Cloud, SAP Commerce Cloud, and SAP Customer Data Cloud. Each cloud is made up of one or more underlying applications, which we'll discuss throughout the chapter.

Integration is a core pillar of SAP's CX product strategy; customer journeys today are complex sequences of events that take place over a number of different channels and technologies. The ability to share information between applications in real time is an imperative for firms looking to build rich and rewarding positive CXs.

During the chapter, we'll break down the major components of the SAP C/4HANA suite by looking at marketing, sales, commerce, and customer service. For each area, we'll explore current challenges and industry trends before explaining what the SAP C/4HANA suite offers in relation to these. To start, let's use a case study to introduce some of the concepts and terms we'll deal with during this chapter.

1.1 Business Case

Bault Robotical has a clear set of commercial priorities and objectives on the CX front. The company determined the following three main goals:

- Deliver 20% year-on-year revenue growth by finding and winning new customers, increasing average order values, and increasing repeat business from existing customers.
- Reduce the number of customers defecting to the new digital start-ups entering the market by improving CX, and becoming more customer-centric.
- Deliver improved levels of employee engagement and motivation by equipping them with the tools they need to be successful.

The commercial division was poorly served by enterprise applications and technology, which was having a negative impact on Bault Robotical's CX. The only dedicated application in use, SAP CRM, was focused predominantly on the contact center. Bault Robotical had previously attempted to develop in-house a sales force automation (SFA) solution and a customer-facing website, however, both projects had run into technical integration challenges and significant user adoption issues. The SFA solution was switched off, and very few customers were using the website, which provided only basic order-creation capabilities. The marketing department had effectively outsourced much of its work to agencies that had the technology required to support them.

The on-premise SAP CRM application required three separate in-house IT staff to provide a complete support model and Bault Robotical was considering outsourcing this to save cost. A recent acquisition of a US-based robot manufacturer revealed it was using Salesforce, and there was pressure on the head office to allow the company to keep it, in the absence of any meaningful alternative.

The most commonly used business application was SAP ERP 6, accessed via SAP GUI, which was where the sales team would enter orders, the contact center would manage complex service requests, and the marketing department would download data.

The IT challenges could be categorized as follows:

- No dedicated CX applications to support specialist functions such as marketing, commerce, and sales
- A high cost to maintain on-premise SAP CRM from a people and infrastructure perspective

- No commercial IT template to roll out when acquiring new firms
- Poor levels of user engagement and attitude toward in-house IT from the commercial business
- Poor CX and engagement generated from the limited technology that was used in the front line
- No single view of the customer due to limited and siloed business applications

To address these challenges, Bault Robotical went through a software selection process and determined SAP C/4HANA as the new CX suite to move forward with based on the following criteria:

- All commercial teams and departments must be able to share customer insight and data through an integrated set of processes and tools.
- IT needs to reduce infrastructure cost and capital expenditure by moving to a cloud-first strategy for enterprise applications.
- Business users must be engaged and compelled to adopt new tools through a positive and rewarding user experience (UX).
- Field-based teams must be able to access key processes and customer information whenever and wherever they need it.
- Customers must be able to self-serve for sales and service transactions to enhance convenience and reduce cost-to-serve for Bault Robotical.
- There must be greater transparency of behavior and performance in sales, service, and marketing to measure and improve business key performance indicators (KPIs).
- Customer data must be more carefully owned and managed to comply with market regulations

A new CX program was launched, based on SAP C/4HANA, to provide new enterprise applications to the sales, marketing, and customer service contact center teams as well as a new self-service solution for customers available via website and mobile devices. A phased deployment, by team, was chosen. Phase 1 included sales and marketing, phase 2 was for the customer service contact center, and phase 3 provided a customer self-service capability. The phased deployment approach was chosen to realize some benefits as soon as possible, which generated funding for the subsequent phases. This approach also helped to manage the amount of change and therefore risk that Bault Robotical and its customers were exposed to at one time.

Now that we've taken a look at how Bault Robotical has implemented an effective CX solution in its organization, let's take a closer look at the processes and how they come together in SAP's modern landscape.

1.2 Marketing

In this section, we'll explore some new and some more traditional challenges that marketing departments face and how the SAP customer service marketing suite of products can be used to address them.

SAP's product strategy in marketing is a mixture of build, buy, and integrate. At the core of the marketing suite is SAP Marketing Cloud, an application developed in-house by SAP that runs on an SAP HANA database (we'll look at the significance of this later in this section). This core product has been complemented by the acquisition of businesses such as Abakus (for attribution modeling) and Gigya (for social login and customer data). Gigya now forms the basis of the SAP Customer Data Cloud in SAP C/4HANA. Finally, integration to other third-party software is provided, such as Sprinklr, Amazon, and SurveyMonkey.

In the following sections, we'll take a look at some of the marketing challenges your business may face today, as well as your marketing options with SAP, from the SAP Marketing Cloud to integration with third-party software.

1.2.1 Challenges in Marketing

The role and rules of marketing have been significantly redefined in recent times. Technology (and by association data) has been a significant driver and disruptor behind these changes. Today's chief marketing officer (CMO) is expected to be an expert in human behavior, big data, analytics, forecasting, attribution modeling, and digital content management, and that's before they get to their day jobs. The CMO has been instrumental in redrawing the lines between IT departments and "the business" and in doing so changed the model for how firms buy and run software.

We'll explore some new and enduring challenges in the current marketing landscape in the following sections.

Data Privacy and Security

One of the single most important factors behind many of today's digital success stories is the firm's ability to listen to and understand its customers. These businesses have identified something that is valuable to customers and made it available quickly. We're now seeing a new trend of firms buying other firms for their data; in fact, we've seen SAP do this with its acquisition of Gigya. Firms are buying customer data to unlock the next growth phase of their business.

The explosion in the availability of new types and new sources of data has posed a huge challenge and opportunity to marketing departments. Firms are overwhelmed with data that *could* unlock the secret to understanding their customers much more intimately. The ability to collect and store that data is the first immediate challenge. Traditional relational database technologies, particular those found under many first-generation CRM systems, aren't suitable for dealing with data at this scale. A related challenge is that of unstructured and semi-structured data, such as text messages, multimedia files, and social media posts, which relational databases aren't good at dealing with.

The second challenge that data poses to the marketing department is how to understand it and make use of it. Imagine we collected tweets from our 10,000 most loyal customers each day. Could we understand them? How would we interpret textspeak, and how would we then act on it? Even supposing that we could understand and act on this information, could we do this in time? If a customer is complaining on Twitter, how long before the customer heads down the road to the competition?

With this proliferation of data, a new problem has emerged for businesses using it: privacy. Customers, particularly consumers, are finally awakening from a period of blissful ignorance about who has their data and what it's being used for.

Governments and regulators are also responding to this problem, making firms much more accountable and transparent in their use of customer data, which presents a new and real risk to those who fall foul of it.

Multichannel Customer Journeys

As customers adopt and use new channels, technologies, and platforms, they are leaving an increasingly complex digital footprint behind them. Solving this puzzle means collecting the various data generated from all of the touchpoints and then connecting the dots to reveal the individual journeys that customers are taking.

For marketing departments, this begins to reveal how, where, and why customers are interacting with the firm. This insight can help explain consumer behavior and indicate how best to reach the customer at key decision points.

Relevant, Contextual, Valuable

Customers are demanding more from the firms they interact with. They expect those firms to understand who they are, what they like, what they need, and, crucially, when they need it. This relies on marketing departments having access to different categories of data and being able to use this information, often in real time.

Historically, marketing departments work with limited sets of information about customers, such as the following:

- Master data: Information *about* the customer, such as address, hobbies, or age.
- Transactional data: Information about *what* the customer has done, for example, previous orders, inquiries, or complaints.

Marketing departments haven't been able to easily access and use the following types of data:

- Behavioral data: Information that describes *how* customers act in specific environments and situations, for example, how they interact with a website, their preferred device for online purchases, and how they research a purchase.
- Contextual data: The ability to join together information already known about the customer, for example, current location, with external data, such as the weather.
- Predictive data: The ability to use existing data sources and run them through algorithms and models to create new data about the customer.

We can consider the simple example of a firm that sells umbrellas and is looking to run a targeted consumer promotion. The company knows that a customer lives in Manchester, and it's raining in Manchester today. The company could target the consumer with a promotion for umbrellas, but the customer is on holiday in Spain. That promotion isn't contextualized for the customer because the firm isn't aware of where the customer is and the customer's need at that time.

Firms that are able to contextualize their marketing activity will generally build better relationships with their customers, which will benefit both parties. To realize this, the firm needs to understand more than just basic details about customers; it needs to know where they are (smart devices are an enabler of this) and what their needs might be based on their location.

Understanding Cause and Effect

Alongside some of the new challenges we've just worked through, there are other challenges that have been present for much longer. A great example of this is understanding cause and effect.

An infamous saying in marketing is that you know 50% of your marketing works—you just don't know which 50%. There can be many objectives of marketing activity, from eliciting a sale to building brand rapport or raising awareness of a new product launch.

Whatever the objective is, it involves an investment of people, time, resources, and cash. It's therefore important that firms invest in the marketing initiatives most likely to yield the best outcomes. This requires the following set of integrated capabilities, which are then used over and over again to refine and improve the return on investment (ROI) from marketing investment:

- Forecast: Produce a plan that states a set of predictions, assumptions, and, ultimately, a financial projection about how a marketing activity will perform and what it will deliver.
- Review and approval: Share a plan and a forecast with key stakeholders that they can scrutinize, provide feedback on, refine, and, ultimately, sign off on.
- Execute: Run the agreed plan and activities, typically as discrete campaigns, generating data through this process to review in the subsequent phase.
- Measure: Use the data generated in the execute phase to produce a set of information that reveals how the plan, activities, and campaigns performed. This information should be structured in a similar form to the forecast to enable a side-by-side comparison of plan versus actuals.

Cost and Automation

Marketing faces the same challenges that any other department in the modern firm has to face. Controlling costs and the endless pursuit of efficiency gains are real life problems in marketing.

One of the specific challenges in marketing is the high degree of repetitive work involved in running the department day to day. These tasks include defining and executing marketing plans; manipulating data to support customer segmentation, maintaining customer segments, setting up and administering similar campaigns, engaging with third parties (e.g., agencies), and creating reporting packs.

These tasks often require a large amount of manual human involvement, whether that is through an insourced or an outsourced model. There is great opportunity for automation-driven efficiency gains here, but also a risk that introducing new technology, if it hasn't been carefully considered, might create more work, rather than less. For many firms implementing a new enterprise marketing application, one of the first things they want to know will be how many people it will take to run it.

Collaboration with Agencies and Third Parties

Agencies provide a number of specialist services to the marketing department, including creative design, data modeling, and brand strategy, as well as providing staff to supplement the in-house team with day-to-day operational aspects. The challenges present in engaging and collaborating with agency teams and staff, particularly in iterative processes such as creative design, can slow down cycle times and lead to inefficiency.

1.2.2 SAP Marketing Cloud

SAP's initial strategy was to deliver marketing through the SAP Cloud for Customer platform, and, indeed, SAP Cloud for Marketing existed as a product in its own right for a short period, offering basic segmentation and campaign management features.

In 2013, there was a change in strategy with the launch of SAP Hybris Marketing Cloud (now rebranded as SAP Marketing Cloud, under the SAP C/4HANA suite), an entirely new product, that was developed on the SAP NetWeaver stack. The application could only run on an SAP HANA database, one of the first SAP business applications to offer customers no choice in this regard. It was originally offered in both on-premise and cloud versions.

The reasons behind this technical design were part of SAP's strategy to break into a heavily congested, enterprise marketing software market. The explosion of data volumes, both in B2C and B2B business, driven from digital channels and ways of working were creating an opportunity that many firms could recognize but not exploit. The ability to collect, store, and query huge volumes of data and then act on the insight this provided in real time was a challenge that many businesses were wrestling with; this was the perfect use case for SAP HANA. For more information about SAP HANA's role in the SAP landscape, see Chapter 14.

SAP Marketing Cloud can be thought of as a set of complementary capabilities:

- **Data management incorporating a single customer view**
  Imagine everything you knew about your customer, joined together and stored in one place, from which you can perform queries and predict customer needs and wants in real time.

  SAP Marketing Cloud is based on a simple data model that allows a customer record to be modeled with multiple facets to reflect the various slices of data that firms might hold about their customers. There is then a generic customer interaction that can be used to represent any customer touchpoint from an order to a click on a website.

  SAP provides standard integration with many of its existing applications, including SAP ERP, SAP S/4HANA, SAP Cloud for Customer, and SAP CRM. For the many firms that store customer data in non-SAP systems, SAP offers the use of standard integration tools, such as SAP Data Services, to draw data from non-SAP applications.

  After a customer data model has been established inside SAP Marketing Cloud, this can be exposed through a single customer view application presented to users through a user interface (UI) that allows marketing users to view the customer and his lifetime history.

  Customer journeys can be visualized through the Customer Journey Insight application, which gathers, organizes, and presents a series of customer interactions into a time-series view. Frequently occurring journeys with the same steps and sequences are grouped to help determine the most common and least common journeys, as illustrated in Figure 1.1.

  It's important to understand that SAP Marketing Cloud isn't a data management platform (SAP does provide this capability, which is described in Chapter 17), although it's an application that relies heavily on data to be effective. The implementation project for SAP Marketing Cloud tends to reveal the issues that exist with a firm's customer data, and there is often a desire to use the application to highlight and fix these on an ongoing basis. The fundamental point to bear in mind here is that SAP Marketing Cloud is pulling data from other applications and merging the data together. It doesn't include data maintenance tools to fix issues or send these fixes back to the source systems and wasn't designed to do so.

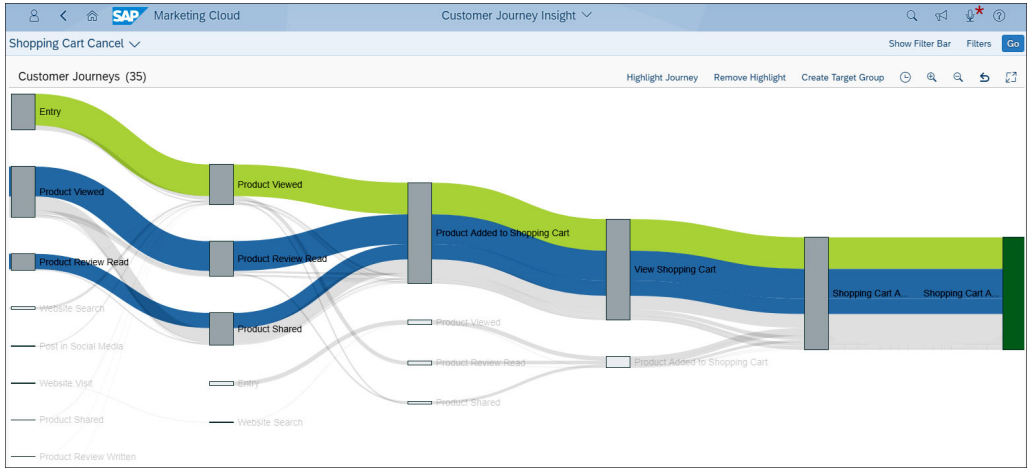

Figure 1.1 A Set of Customer Journeys from SAP Marketing Cloud

- **Segmentation**

  The Segmentation application creates groups of customers with similar characteristics or behavior; this group will then be targeted with a specific marketing activity or event. This is the first use case where the value of the underlying SAP HANA database can be realized. We talked earlier about the increasing size and complexity of customer data. The SAP HANA database offers a means to store and query massive volumes of complex customer data in real time, creating new opportunities for marketing professionals to ask questions of data and segments based on the answers they get. This can be particularly useful in B2C industries for firms who deal with millions of customers and their associated transactional and behavioral data.

  Segmentation is presented as an interactive waterfall type application within the SAP Marketing Cloud. Initially, all customers are presented as a group, and the user creates and applies a series of filters to reduce the group down to the final set. These filters can be based on anything that is known about the customer, including master, transactional, and behavioral data. The output from the segmentation process is a segmentation profile (recording the details of the segmentation process) and a target group that records the customers selected for targeting. The Segmentation application is shown in Figure 1.2.

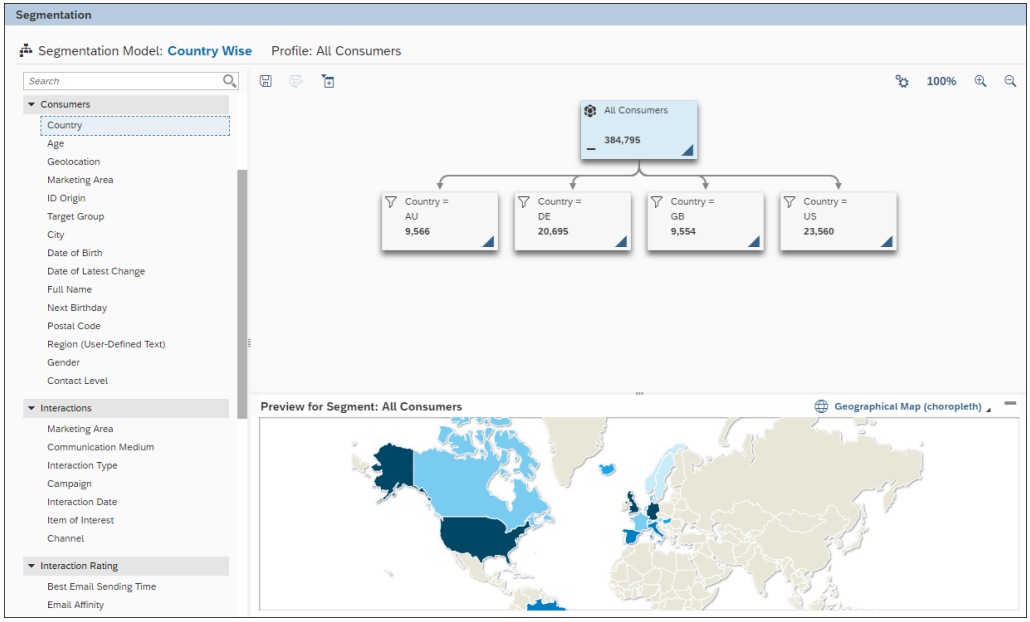

Figure 1.2 Geospatial Customer Segmentation with SAP C/4HANA

- **Campaign management**
  Campaign management is the engine room of the application. Here marketing campaigns and activities can be modeled and run through a plan > execute > analyze process to drive iterative improvement and learning from each cycle of activity. For example, a campaign can be used to manage an in-store consumer promotion, a brand launch on Facebook, or a product recall run via email.

What's Right for You?

A number of standard execution channels are provided for including email, SMS, Facebook, and third-party providers. Where email and SMS execution are required, an email service provider (ESP) and SMS gateway will be required; SAP offers these on a subscription-based model.

Determining which execution channels are right for your business depends on a number of factors, including customer preferences and the nature of the conversation you want to have with them. Email and SMS are very direct channels and can be considered intrusive, particularly if your message or offer isn't considered relevant

and valuable by the recipient. Facebook as an execution channel is a softer, targeted advertising option that is considered less intrusive by customers.

When determining your channel strategy, consider your customers' preferences first and the conversation you want to have with them. You'll also need to consider regulatory rules, such as General Data Protection Regulation (GDPR) in the European Union, when planning your campaigns.

Integrated into campaign management is the Customer Journey Builder application. This helps marketing professionals design complex multistage customer journeys using a series of steps and decision points and tailor these to the needs and behavior of individual customers. A common use case for this is nurturing campaigns in B2C. From the point consumers initially register on the website, there is a short window in which to convert them into paying customers before their interest is lost.

Through Customer Journey Builder, a series of targeted email and SMS messages can be sent and the consumer's responses tracked. If no reply is received after 5 days, then the application will automatically send another email. If no reply is received after 10 days, then the Customer Journey Builder can be set up to send a 10% off voucher. If no reply is receive after 20 days, an email can be sent to the call center to get an agent to call and invite the customers into the store.

There is a content capability associated with campaign management that allows marketing email, SMS, and website landing pages to be designed and used in conjunction with campaigns. This includes the ability to personalize and tailor individual customer interactions based on the customer data held (this might be master data to transactional data).

- **Planning and forecasting**
  SAP Marketing Cloud provides the capability to build a complete marketing plan down to and linked in the individual campaigns that will be run as part of this. The plan itself is a hierarchical structure, and budget planning can be completed against the various points. This helps the marketing department manage a budget, allocate monies to specific parts of a plan (e.g., by brand or by media), and model ROI. Figure 1.3 shows a marketing plan in SAP Marketing Cloud.

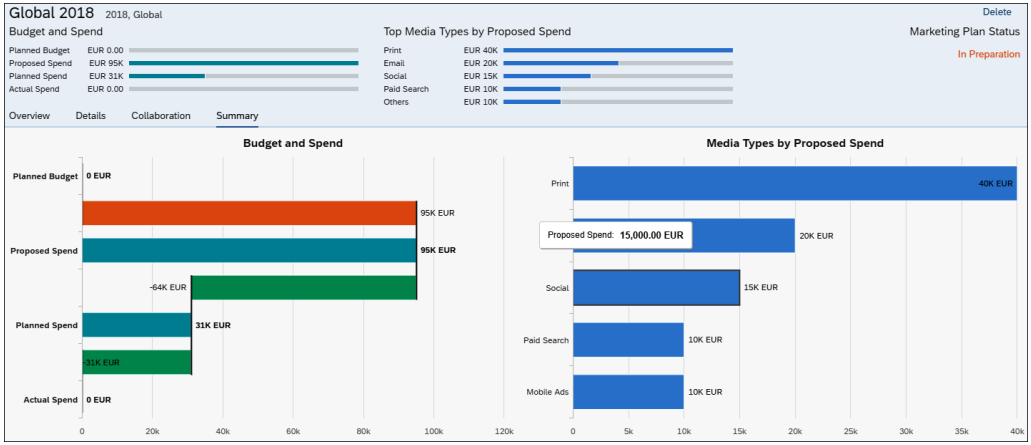

Figure 1.3 Marketing Plan in SAP Marketing Cloud

By establishing a plan and budgetary framework, it becomes possible to track actual spend and performance against a budget to determine any variances and correct them. Integration is enabled between SAP Marketing Cloud and SAP S/4HANA (as well as SAP ERP releases) so that purchasing transactions (e.g., to procure TV airtime, a creative agency's services, or in-store signage) can be assigned against the marketing plan.

- **Lead management**
  This is generally more relevant in B2B scenarios (although B2C use cases for leads do exist) and provides an ability to bridge the gap that can sometimes exist between the marketing and sales departments. Leads can be generated in SAP Marketing Cloud through a segmentation and campaign execution process. These leads can be transferred to SAP Cloud for Customer and SAP CRM via standard integration where they can be followed up by sales teams for conversion into opportunities.
- **Approvals**
  The Approvals application includes an approval capability for items such as campaigns as well as target groups and content items such as email templates. This can be used to ensure that the appropriate levels of scrutiny and organizational review and sign-off are applied to marketing activity and customer communications.
- **Analytics and dashboarding**
  Analytics provides insight into whether the marketing activity has delivered the

results that were defined during the initial planning phase and produced a positive ROI.

The application ships with a standard **Marketing Executive Dashboard** screen, targeted at C-level marketing professionals and senior management users. This dashboard provides a holistic view of all marketing KPIs and metrics to help manage the marketing department. There are additional lower level reports that provide insight into campaign responses rates.

Standard integration is provided to SAP Lumira, which can be used to query and present application data stored in the SAP HANA database, allowing firms to develop their own suite of tailored marketing analytics and reports.

- **Data privacy and protection**
  SAP Marketing Cloud includes a full set of capabilities to record customer preferences and permissions. These areas of information are checked in key processes, such as segmentation and campaign execution, to ensure only customers with appropriate permissions are contacted. The product also contains a double opt-in capability where customers are asked to confirm their email address after initially registering to ensure consent has been provided.

  Through a landing page concept, which firms can embed into their company website, customers can self-serve when updating their privacy, permissions, and preferences data.

- **Predictive**
  Leveraging some of the native capabilities of SAP HANA, SAP Marketing Cloud includes standard models to predict customer behaviors such as buying propensity. This can support a number of use cases, for example, segmentation, where two target groups might be created for customers with different levels of propensity to buy. These target groups can then be used in two different promotional campaigns with differing tactics, media, and mechanics.

  Subject to SAP licensing conditions being met, SAP customers are able to develop their own predictive models for other customer behaviors and attributes.

1.2.3 SAP Acquisitions in Marketing

Alongside the in-house development of SAP Marketing Cloud, SAP has made several key acquisitions to accelerate the development of its overall value proposition and to grab a larger share of the market:

- Abakus, an attribution modeling solution, enhances the budget modeling and scenario planning aspects of the core solution. Attribution modeling helps businesses to understand which parts of their sales and marketing activities are most effective in delivering desired outcomes.
- The acquisition of Gigya, which describes itself as a "customer identity management platform," was interesting for a number of reasons. This enhanced SAP's capabilities in areas such as opt-in and profile management, while also presenting SAP with access to huge volumes of online customer data that could yield new insight and value. The ability to create and manage complex customer profiles (think of this as the single view of the customer) is a key component of the SAP marketing architecture and provides the data on which the applications run.

Besides their expansion through acquisition, SAP continues to partner with other enterprise marketing solutions and CX solutions in general. This partnership typically takes the form of certified integration to specific products; the current list includes SurveyMonkey for survey management and Sprinklr for social CRM integration.

1.3 Sales

Customers are more powerful today than they have ever been. They have more choice than ever before, more information with which to make these choices, and greater expectations of the firms that they buy from. This is an exciting time to be a customer. For the suppliers of the world, this means they have to work harder than ever to succeed.

In this section, we'll focus on sales and how this entire area of business is being rethought and redesigned, driven by advances in technology. We'll explore the new ways that firms and their sales teams sell, changes in how customers buy, and how this is supported through the SAP Sales Cloud.

We'll consider the differences between B2C and B2B in this section because selling to millions of consumers requires a very different sales model than selling to a handful of business customers.

SAP provides sales solutions and features through two distinct product sets: SAP S/4HANA and SAP C/4HANA. This is a useful way of thinking about SAP's CX strategy generally. SAP has always provided transactional sales processes through its SAP ERP product suite (R/2, R/3, SAP ERP, and now SAP S/4HANA). SAP ERP capabilities are

generally more back-office in their nature and include areas such as order-to-cash, pricing, contract management, and revenue management. We'll focus on SAP S/4HANA in the next chapter. The second product set (which we'll focus on now) is SAP C/4HANA, and these are specialist CX applications, typically used in the front-office area supporting staff directly engaging with customers.

1.3.1 Challenges in Sales

Because it's such a broad topic, we'll look at sales through three points of view, before diving into the SAP Sales Cloud functionality:

- The customer's (and consumer's) point of view because they are often driving the change
- The salesperson's point of view because there is a very real human element to sales
- The supplier's point of view because they have most to lose or gain

The Customer's View

Consumer adoption of new technology and its ready availability have been hugely significant. We'll deal with commerce in Section 1.4, but almost everyone reading this book has likely purchased something on a smart phone, tablet, or desktop computer. Almost all of us have purchased something from an online platform such as Amazon or Alibaba. Most of us have used a price comparison website and sought out reviews from our peers who have purchased a product we're considering. In combination, these points serve to create the following changes:

- Consumers are buying in different ways and through different channels.
- Consumers expect convenience and the firm to know what they want and when they want it.
- Consumers have more information available to them when considering a purchase, including price.
- Consumers have more choice when making purchasing decisions.
- Consumers have significantly higher expectations of the firms they buy from in terms of price, service, and quality.

We see these changes in B2B businesses too. B2B firms are buying through new channels and devices. We've advanced from orders being posted and faxed to a world where connected business networks allow suppliers to predict the needs of their customers based on demand signal data and to then place orders on their behalf.

B2B customers are demanding more information and a greater level of responsiveness from their suppliers, another trend that we've seen in B2C recently. Customers expect the firms they buy from to be available 24/7, not just for the purchase transaction itself, but to deal with inquiries, technical product queries, and anything else they require.

The Salesperson's View

There is a human element to the changes we currently see in sales. Salespeople are having to adopt a range of new technologies very quickly because their customers are using them and expect salespeople to do the same. New generations, who have been raised on iPads and social media, are now young sales professionals, and they expect these technologies to be a part of their professional lives.

Integrating new technology into sales processes while maintaining the CX and engagement is a challenging task in itself. When CRM and CX projects fail, there is almost inevitably a user adoption issue at the heart of the problem. Millennials and Generation X sales professionals already know what a good UX feels like, so corporate technology projects are now judged accordingly. Salespeople are now connected to their customers and their customers' data 24 hours a day. There is a new challenge to deal with—information overload. As the data footprint of customers increases, knowing which information is important, how to access it, and then, crucially, how to use it, is a new skill for salespeople.

The increasingly complex nature of sales processes also poses a challenge to the salespeople who are involved with them. Customer journeys are now more complex, in part because they often take place over multiple channels and technologies. Think about someone you know who has bought a car recently. For every face-to-face meeting with the salesperson in the showroom, there were probably five more that took place on the web, on Facebook, and any number of review sites. This means salespeople are having to sell, sometimes without a full awareness or understanding of the interactions the customer has had; it also means that in the moments where they are in front of the customer, they have to make them count.

Salespeople continue to be incentivized predominantly by numbers, in particular their financial targets. To keep delivering their numbers, in an increasingly competitive global marketplace, salespeople need help to be productive and effective in what they do. Productivity means being more efficient in routine tasks, such as visit preparation, traveling, meeting write-ups, and analyzing results. Being effective means improving your chances of winning by chasing down the deals you're most likely to

win, abandoning the deals you can never win early on, and putting the right deals in front of customers at the right time.

And, finally, the actions of salespeople are becoming increasingly transparent, as they themselves leave a trail of data behind them in their daily routines. Which customer did they visit, for how long, where did they stop for lunch, and how fast did they drive to an appointment? This information is available and is scrutinized by sales managers looking to extract more from their teams. This leads us to an increasingly important topic in sales—trust. With this greater level of scrutiny, there is a risk that the trust between the salesperson and the firm can be broken.

The Firm's View

Firms are operating in increasingly competitive and complex markets. Technology has removed barriers to entry in many industries and created international and global markets that previously didn't exist. To succeed in this environment, it's necessary to think and act differently. To stand out from the competition, firms are now looking to develop more personal relationships with their customers, based on trust and goodwill, which is harder for competitors to copy. A second obstacle to succeeding in highly competitive and disrupted markets is agility. Firms may need to change strategy or direction in response to changing market conditions and to execute these changes through the sales team to capitalize on an opportunity or to head off a threat. Particularly for firms with large field sales teams, who spend much of their time out of the office, implementing change can be difficult.

Sales processes themselves are changing. Firms are having to rethink their strategy and processes to ensure they invest their sales force into the customers and opportunities likely to yield the greatest outcomes. The relationship-based selling model, where the same customer is called on once a month, every month, is under challenge. Predictive technology, powered by ever-growing volumes of customer data, can now direct salespeople to the customers and opportunities most likely to yield a sale (and a commission check). This involves salespeople not just adopting technology but learning to *trust* in it.

Digital Disruptor

With this glut of customer data now available to firms, there is an opportunity to use it intelligently to improve sales. Data is a huge untapped asset for many firms with a huge potential upside if they can unlock the information inside and place this insight at key points in sales processes and customer journeys.

This insight might be knowing exactly how much each customer would be prepared to pay for a product, which product an existing customer is most likely to buy next from you, or when a customer is likely to buy from the competition. If firms had this insight, and often they have the raw ingredient—data—then their sales function could be significantly more effective.

With SAP HANA and SAP Leonardo, firms are able to develop their own predictive models and insight, fueled by data captured in the SAP C/4HANA suite as well as external sources. Putting this insight into the hands of sales teams allows them to understand their customers better and predict their future needs.

1.3.2 SAP Sales Cloud

SAP Sales Cloud includes the original SAP Cloud for Customer (Sales) product that SAP developed on the SAP Business ByDesign platform. This was one of SAP's first CX software-as-a-service (SaaS) applications, which meant no local infrastructure for the customer, a browser-based UI, rapid deployment cycles, four releases per year, and a subscription-based license model. Today it includes functionality from SAP's acquisition of Callidus Cloud.

All SAP Cloud for Customer variants were built on a common foundation which included the following:

- Standard integration from and to an SAP ERP system (mainly in the Sales and Distribution [SD] module)
- Question-driven configuration that allowed the solution to be tailored to a customer's requirements very quickly
- Limited scope to provide for nonstandard customer requirements through a lightweight scripting language, Advanced Business Scripting Language (ABSL)
- A ready-to-run mobile version capable of operating offline for iOS and Android
- Integration with Microsoft Outlook
- The ability to define and build mash-ups pulling features and data from other SaaS applications and blending them with SAP Cloud for Customer

SAP Sales Cloud provides support across the extended sales cycle from lead to order for HQ and field-based salespeople. It focuses on simplifying or automating repetitive low-value tasks and draws together information from front-office and back-office processes to empower salespeople who are dealing with customers.

In 2018, SAP acquired Callidus Cloud, a SaaS sales force management business based in California with specialist capabilities in the areas of sales force effectiveness, sales performance management, and configure, price, quote (CPQ; used predominantly by make-to-order [MTO] businesses). There is significant overlap in the capabilities of Callidus Cloud and SAP Cloud for Customer, and SAP's new challenge is to converge these products with the SAP Sales Cloud.

Both SAP Cloud for Customer and Callidus Cloud are heavily B2B focused because they are based around visits and opportunities that make little sense in a B2C scenario (or very rarely).

SAP Sales Cloud also includes functionality that was formerly part of SAP Hybris Revenue Cloud, providing extended order and contract management capability along with pricing and billing features that can be integrated into SAP S/4HANA and SAP C/4HANA order-to-cash processes.

Let's start by setting out a basic B2B sales process that the SAP Sales Cloud will support (we'll deal with B2C sales through Section 1.4). We'll refer to this as the extended sales cycle, as it particularly focuses on the activities and events that happen before an order is created; we'll deal with the more common order-to-cash aspects of the process in Chapter 2, although they are highlighted here for clarity.

It's common for long-standing SAP customers who run SAP ERP or SAP S/4HANA to look at the SAP C/4HANA extended sales cycle and raise questions about features already available in their SAP ERP system (order management being a particularly good example of this). SAP ERP applications generally cover the order-to-cash cycle (order, delivery, and invoice) adequately, however, the extended sales cycle isn't well covered and requires a specialist CX application, such as SAP Sales Cloud. The order-to-cash and extended sales cycle is illustrated in Figure 1.4.

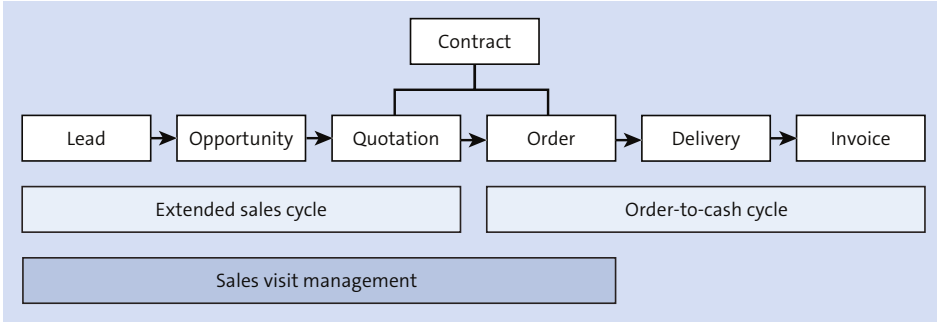

Figure 1.4 The Order-to-Cash and Extended Sales Cycles

The extended sales cycle includes the standard order-to-cash process (order, delivery, and invoice) and manages the presales phases that lead toward an order. This includes the lead, to cover an early stage expression of interest; opportunity, where there is a more concrete customer requirement; and finally quotation, where a formal offer is made to the customer.

The SAP Sales Cloud contains a set of capabilities focused on delivering improved efficiency and effectiveness to sales professionals:

- **User experience (UX)**
  This point is key to delivering user adoption, which is a common reason that CX technology projects fail. The SAP Sales Cloud is built as an SaaS application capable of running on any device with a browser, including mobile devices such as smartphones and tablets. There is an Android and iOS app available to run this solution on smart devices too. This allows sales professionals to use it both in and out of the office. The application has been designed using user-centric design principles to be highly intuitive and easy to use. An overview of the SAP Sales Cloud and its UX approach is detailed in Figure 1.5.

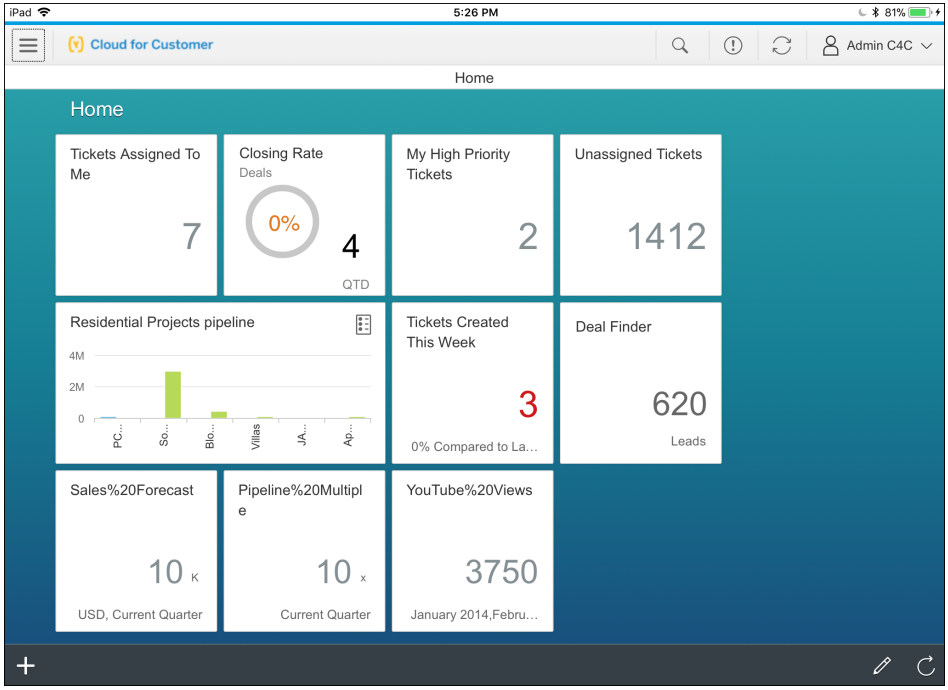

Figure 1.5 SAP Sales Cloud UX

- **Automation**
  The solution automates common repetitive tasks such as producing reports, scheduling visits and sending emails. This is important because it frees up time for salespeople to focus on the important aspects of their role.
- **Collaboration**
  It's possible to integrate SAP Jam, a social collaboration product that allows groups of users to share content, ideas, and experiences in real time through a Facebook style feed. This is particularly useful when salespeople are working in the field or remotely and can't meet face-to-face.
- **Single customer view**
  By drawing together all useful information about a customer into a single view, salespeople don't need to spend their time searching for reports and information when they are preparing for a visit, which creates an efficiency saving. This capability also ensures the salesperson is kept up to date with important new information about a customer, which can be a challenge when there is so much information generated and stored about customers today.
- **Integration**
  Integration with SAP S/4HANA and SAP ERP is provided for master and transactional data. This means a salesperson can check whether a customer received a delivery, an order created on a mobile device is automatically transferred to the SAP ERP system for fulfilment, and changes in customer data made by a sales representative in the field are automatically synchronized with the SAP S/4HANA customer master record. There is also standard integration to applications such as Microsoft Outlook for bidirectional email integration. These standard integrations help to accelerate the deployment process and ROI windows of the project.
- **Integrated analytics**
  A set of standard integrated reports is provided to help salespeople understand their customers and their own performance. These reports can be enhanced by business users who don't need an IT background to make these changes. A key element of the analytics solution is pipeline management, which helps a business create a forward revenue forecast and identify any issues with this early.

Beyond the basic capabilities, there are a set of specialized capabilities. The following capabilities might be used in specific industry use cases, for example, CPQ in MTO businesses or to support advanced sales processes such as content-based selling:

- **Configure, price, quote (CPQ)**
  This capability is specifically for MTO businesses where each product sold is

defined by a set of parameters (the configurable aspect). The solution allows products with a set of configurable parameters to be defined; the resulting model is integrated into the sales and manufacturing process to ensure that a customer's unique requirements are captured in an order that is then passed to production. The order itself might be created by a sales professional or directly by the customer via the web.

- **Content**
  The ability to manage and distribute digital content to sales teams is available, which allows sales professionals to call up contextual collateral at critical stages in a sales process. It's possible to distribute specific content to individuals based on their customers and current opportunities.
- **Survey management**
  One of the common challenges with first- and second-generation CRM applications is that they don't provide structured data from customer visits that can be interpreted and acted on. Survey management allows specific information-gathering tasks and exercises to be passed to the sales team to collect specific data and information.
- **Campaign management**
  Aligning sales and marketing effectively is a key challenge in most firms. The SAP Sales Cloud allows leads generated from SAP Marketing Cloud campaigns to be automatically scored and prioritized, distributed to salespeople, and then converted into orders. This solution helps to minimize the lag between a lead being created and followed up, which is a common reason for leads to be lost.
- **Revenue planning**
  This allows salespeople to carry out financial planning against their accounts and provides opportunities to produce a detailed revenue forecast that they can use to compare against their personal target and the overall business budget.

1.4 Commerce

Commerce has traditionally been thought of as a platform that businesses use to sell their products and services to customers over the Internet. As customer and consumer habits have changed, this definition has become too narrow, and firms now seek to offer a much broader range of services, information, and experiences through commerce. What we mean by commerce is now much more than a simple online

shop. Commerce is a single point of access for customers to reach a firm's sales, marketing, and customer service teams; even back-office teams, such as finance, logistics, and supply chain, are now within reach. For most firms, commerce is an integral component of their wider commercial strategy.

Commerce platforms today allow firms to do the following:

- Design and implement highly personalized customer journeys using data about the customer.
- Connect physical channels such as brick-and-mortar retail and other digital channels such as social media to create new seamless experiences for customers.
- Deliver consistently high-quality sites to a range of devices and form factors.
- Deliver digital content, such as video, to customers.
- Provide access to back-office teams and departments to help customers achieve their goals.
- Collect and store information about each individual customer and their tastes and preferences.
- Manage customer data privacy.
- Integrate sales and marketing processes.
- Provide customer service functions, such as complaints management and returns management.

In the following sections, we'll cover the challenges companies face in commerce and the current solutions offered by SAP.

1.4.1 Challenges in Commerce

Consumer buying behavior and journeys have become complex multistage processes carried out over multiple physical and digital channels, resulting in a challenge for firms to ensure all these steps are connected and consistent. Solutions such as click-and-collect require point-of-sale and warehouse management systems to be integrated with the commerce platform to provide a slick and positive experience to customers.

Consumers themselves are driving further innovation and change as they access commerce through new devices and channels. Mobile commerce in particular has seen a huge rise driven by consumers wanting to use the convenience of their smartphone to research and shop with.

It's often tempting to immediately think of B2C firms when considering commerce, and indeed this sector has pioneered new strategies and technologies generally. Today, B2B firms also are exploiting commerce in new innovative ways, for a number of reasons:

- Allowing firms to sell to customers who were traditionally considered too small to hold a formal commercial relationship with
- Providing a means to offer customers a round-the-clock suite of services, including order capture, complaint handling, and account access
- Helping to reduce cost by delivering interactions and services that previously required staff at HQ to provide
- Creating a means to deliver information and digital content to customers in a controlled and structured way
- Offering a means to reach, engage, and convert new customers without needing to visit or call them

In some industries, commerce is redefining traditional B2B and B2C business models. In fast-moving consumer goods (FMCG), manufacturers are now using commerce to sell to consumers directly whereas previously, their routes to market were always via retail and wholesale third parties. As a direct result of this, manufacturers now enjoy much closer and more direct relationships with their consumers, which help them to develop and sell the next generation of brands and products more successfully.

Digital Disrupter

Commerce has enabled the rise of Internet-only retailers who have been able to force their more traditional competitors out of market share by avoiding the costs associated with physical retail stores. This in turn is creating consolidation, as large online retailers become a convenient one-stop shop for a shopper's complete needs, generating economies of scale and forcing smaller manufacturers and suppliers to sell through the new retail giants.

We discussed customer data earlier in this chapter, and commerce provides opportunities to use customer information to great effect. Data creates an opportunity to personalize pages, offers, services, and visits that are tailored to the unique needs of each customer. These same data can also be used to predict what customers might want and need in the future, acting as the fuel to artificial intelligence (AI) engines that can convert this data into insight that can be acted on. The key is to create this

actionable insight in a timeframe that allows it to be used and made effective. It might be possible to predict that a user is about to abandon their shopping basket and leave the page, but if that prediction takes three days to compute, that moment is lost. Harnessing customer data, converting it to actionable insight quickly, and then acting on it is one of the current challenges in commerce.

1.4.2 SAP Commerce Cloud

The SAP Commerce Cloud is based on the market-leading commerce platform that SAP acquired with the purchase of Hybris. Customers now have three options to acquire and run the solution:

- A pure SaaS version, the SAP Commerce Cloud
- A private cloud version, also called SAP Commerce Cloud
- An on-premise option called SAP Commerce

The solution is available with B2B and B2C templates recognizing the distinct requirements these two categories generate, as well as business-to-business-to-consumer (B2B2C; for industries such as FMCG). These templates are designed to accelerate the implementation process.

Let's explore the features of SAP Commerce Cloud further:

- **Channels**

  The new nature of customer journeys, particularly in B2C where a single journey might span multiple physical and digital touchpoints, is supported and underpins much of the solution. The commerce platform provides support for mobile, in-store, and web channels.

  The solution will support the development of content and sites that run on smartphones, tablets, and desktops catering to the different devices and form factors that customers might use to complete a single objective or journey. There are standard mobile pages available to support product searches and store locations.

  A software development kit (SDK) is provided for firms that want to create their own apps, which deliver better UX on mobile devices rather than simply accessing a site through the device's browser. And, finally, there is an in-store option, which provides a solution for in-store staff to use when dealing with customers face-to-face. This allows the in-store sales representative to call up details about the customer, the customer's history, recent orders, and products of interest.

- **Personalization**
  Earlier, we discussed the importance of personalization to ensure that the individual needs and wants of customer are met. The solution offers the ability to create personalized content and offers to customers based on information that is known about them. This scenario is based on target groups, created in SAP Commerce Cloud or in SAP Marketing Cloud, to serve different pages to different customers when they visit a site. This starts to bring the concept of real time and personalization to life, delivering more relevant and contextual information to the customer and improving the overall effectiveness of the site. The SmartEdit suite allows the content to be created and managed before linking it to target groups to serve it correctly.
- **Integration**
  The solution includes standard integration with SAP S/4HANA, SAP ERP, SAP Sales Cloud, SAP Marketing Cloud, SAP Service Cloud, and SAP CRM. This allows customer-related information in these platforms to be synchronized with the SAP Commerce Cloud platform and used in processes and journeys that span multiple applications. This is particularly useful in B2B scenarios where a customer portal is being deployed with the intention to give customer users access to back-office information, such as dispatch and credit control in a self-service model. It's possible to show the current progress of a delivery and current credit status through this route.

  The product itself also includes an integrated customer service functionality that allows customers to raise service requests and complaints through the same site.
- **Content**
  Within the SAP Commerce Cloud portfolio, there is a specific application to deal with product content management. This covers all aspects of product information management, including management and maintenance of product catalogs and product content in complex multistage workflows. This allows firms to use the digital content they have in the positioning and selling of products, providing a richer experience to customers and ensuring that key selling points and information are effectively communicated.
- **Order management**
  The solution includes comprehensive order management features, such as shopping cart and checkout capabilities, along with a basket abandonment solution to help minimize the number of abandoned carts and the lost revenue associated with these. The order management solution includes integration with SAP S/4HANA and SAP ERP for information such as pricing, discounts, and customers,

and it will synchronize orders between the two applications as well. There are synchronous and asynchronous models available that can be used to insulate the SAP ERP system from the load created by external customer traffic.

Support for return orders is also provided along with a customer service add-on that allows service requests and complaints to be raised from within the same platform. This helps to create the one-stop shop concept for customers, allowing them to carry out all mainstream tasks on a self-serve basis from a single point of access.

- **Commerce capabilities**
  The platform includes an exhaustive set of capabilities with which to build and deploy a multichannel commerce solution. These include search and merchandising, promotions management, and payment and subscription services.

1.5 Customer Service

Customer service typically refers to the events and activities post-sale. It's here that customer inquiries and complaints are raised, warranties are taken out or extended, and advice, maintenance, and fixes are provided. Customer service is now recognized by many firms as an opportunity to build longer, more valuable relationships with customers and to reduce the chances for defection. For firms who can master this, customer service is no longer the end of the customer journey, but a springboard to start a new chapter in the customer lifecycle.

While individual industries will differ based on their unique requirements, we can think of customer service in terms of a basic end-to-end process that applies in most cases:

1. **Register**
   This step covers the setup of a contract or warranty and represents an agreement between the firm and the customer; it might be automatically included when a product is sold or purchased separately by the customer. The purpose of the agreement is to control entitlement, which is covered in the next step.
2. **Request**
   This refers to a request for service, which might be a warranty claim, a complaint, an inquiry, or a general request for service. Where a contract or warranty exists, this can be used to check entitlement; for example, if a product was accompanied

by a two-year warranty, the customer's request for a replacement due to failure of the existing product can be fairly assessed.

Customers can make this request through multiple channels (we'll deal with these shortly) and thanks to technology such as Internet of Things (IoT), smart products can now request service themselves. Entitlement extends beyond simply checking whether the customer is *contractually* eligible to something. It also involves ensuring that the customer's request is fair and reasonable or, at the very least, something that the firm wants to deal with.

3. **Record**
   This step accurately records the customer request, which might involve a contact center agent filling out a complaint or the customer creating this themselves through a self-serve option. This step is important because it will provide the foundation for all subsequent steps in the process.
4. **Resolve**
   This is the process of dealing with the customer's request, which might be a simple inquiry for some product information or a complaint within which the customer is seeking compensation. Within the resolve phase, there is often an initial analysis or investigation step. We talked earlier about entitlement. Imagine a customer that buys a small family hatchback car and then attempts some extreme off-roading. When their new vehicle breaks down, they might complain and request a replacement, but they're probably not entitled to one. This needs to be assessed during investigation.

   Assuming the firm agrees that the customer is entitled to a resolution, this then needs to be delivered. For a simple information request, this could involve nothing more than sending them a product data sheet. For a complex piece of mechanical plant equipment, it might mean sending a team of field service engineers, with parts and tools, to repair the problem on-site. Where complaints are concerned, this might involve agreeing to pay the customer compensation, which requires approval.
5. **Relay**
   This step involves sharing the final outcomes and actions with the customer to ensure there is alignment and understanding between both parties and that the request itself can be closed.
6. **Report**
   This entails the analysis of customer service events and transactions, which might

be used to understand actual levels or standards of service that have been provided. It can also cover root-cause analysis to determine underlying problems in a process a product or even a batch of a product; the objective here is to understand root cause issues that need to be tackled at the source to prevent future occurrences of problems. This report phase is becoming increasingly sophisticated as firms look to leverage the data generated in customer service cycles to predict future issues and address issues proactively, sometimes before they have happened or the customer is aware of them.

In line with the other sections in this chapter, here we'll focus on the SAP C/4HANA aspects of customer service, such as field sales and contact centers; we'll deal with the customer service processes and functions delivered by SAP S/4HANA in the next chapter. There are still areas of overlap between SAP C/4HANA and SAP S/4HANA, which inevitably raise questions for SAP consultants and customers. We'll do a full comparison of the deployment options in Chapter 2, Section 2.5.

To break down this broad topic, we'll look at customer service in three parts. First, we'll look at common challenges in customer experience; next, we'll look at the channels through which service is requested and delivered, which will cover topics such as field service and contact center; finally, we'll cover some of the new technology that is disrupting customer service.

1.5.1 Challenges in Customer Service

The rise of social platforms in particular has disrupted traditional customer service business models. Consumers have been quick to adopt Twitter and Facebook as channels to request service through, and this has created big challenges for customer service departments. Traditional contact center applications don't integrate with social platforms, and the agents using them don't always understand how to use social media as an end user let alone as a service provider. In spite of these obstacles, consumers continue to use social media and firms have to adapt; after all a complaint is a complaint, whichever channel it's raised through.

IoT is having a material impact on customer service models today. Smart devices are capable of self-monitoring and diagnosing and then transmitting service requests to the firm with detailed information about the nature of the issue and the fix required. We see this technology in everything from passenger vehicles to printers.

Digital Disrupter

It may sound like science fiction, but robots are increasingly integrated into the world of customer service. Customer service agents are being replaced by robots and chatbots capable of interpreting, analyzing, and responding to service requests. The role of humans in the customer service department is changing from frontline processing of commoditized work to a specialist that deals with escalations and exceptions that the robot hasn't learned to deal with (yet). In an automated customer service department, the new challenge for the firm is maintaining authenticity, trust, and CX levels.

AI is also making a big change in customer service. While smart devices can self-diagnose and request service, their other purpose is to generate data, which can be transmitted back to HQ. When this data is scaled up, it can feed AI models and devices capable of identifying trends and patterns that can then be used to predict future issues and points of failure, before they become problems for customers. AI is also being used by customer service departments to detect fraudulent claims from customers (think back to the request, or entitlement, step of the process), which helps to manage and control cost.

And, finally, collaboration technologies are being used by firms as a means of extending the self-service concept. By enabling customers to share experiences, ideas, and knowledge, firms are effectively outsourcing the resolve stage of the process (which we'll discuss in the next section) to other customers. This benefits the firm because the company incurs very little cost, and it benefits customers because they often relate better to one another than to an agent. Some firms are seeing so much benefit from collaborative self-service models that they are incentivizing their customers to participate through gamification. For each inquiry that a customer can resolve on behalf of the firm, they are awarded points and rewards.

1.5.2 Customer Service Channels

The channels through which customer service is delivered and requested generate very different processes and requirements. Let's explore the most common channels:

- **Contact centers**
  Contact centers provide support to customers via a range of channels that historically have included telephone, fax, and email. The traditional model was to put a

group of agents in a building with a telephony and email system, publish a phone number and email address, and wait for customers to request what they need. Customers tended to look on contact centers as a necessary evil, and staff motivation and attrition were common challenges for customer service directors to deal with.

Today, there is a different generation of contact centers. Technology allows agents to work remotely from home, which can positively affect staff morale but presents new challenges in how agents work together and share knowledge; customers are adopting new channels, such as chat and social media platforms, to engage the customer service department through. AI is helping agents identify customer fraud, convert a service request into a sale, and understand how to deal with a complaint most effectively.

- **Field service**
  Field service application is also undergoing radical change. As technology advances, the products that field service engineers are fixing have become more complex. Mechanical engineers now need to be software engineers too, as devices such as ovens and vacuum cleaners are becoming smart. This creates challenges in learning and development, particularly for a group of employees that spend most of their time out of the office. As inner cities become more congested, even the simple act of getting to a visit on time is no longer straightforward. And when the engineer does arrive on-site, the customers are more demanding. The customer expects immediate solutions, not a follow-up appointment in two weeks when the right part has arrived in stock. Setting up field service teams for success in this environment is challenging.
- **Self-service**
  Self-service enabled through the extended role of commerce platforms is now allowing customers to access the services and information they need at a time and place of their choosing. This can offer great benefit to both the firm (it's cheaper to let the customer serve themselves than pay an employee to do it) and the customer (the convenience factor) providing it can be implemented effectively. A specific challenge to implementing a self-service model is connecting the self-service platform to the other enterprise applications that hold the answers to the questions the customer is asking.

A common theme across all of these channels is the need for firms to act in customer-centric ways. The way that firms structure themselves often doesn't make sense to customers. We have all had personal (bad) experiences of calling a contact center and being passed around multiple departments to speak to someone who can help. As a

customer, after we've presented our problem or request, we're entitled to expect that the firm will now own and solve that problem. Too often, the customer is expected to navigate and understand the organizational structure of the firm, often acting as a point of collaboration between different departments. This must change, and the best customer service departments are set up to deal with this, from a people and technology point of view. The rest must follow. In other words, whichever channel the customer request is received through, the firm needs to take that problem and proactively solve it.

1.5.3 SAP Service Cloud

SAP has been offering customer service solutions since the days of its first R/2 ERP product. Today, SAP delivers customer service capability through two application portfolios, SAP C/4HANA and SAP S/4HANA. We'll deal with SAP S/4HANA in the next chapter, so here let's look at what SAP C/4HANA has to offer.

The SAP Service Cloud contains both the service functionality of SAP Cloud for Customer as well as SAP Customer Engagement Center. There is an element of overlap between these two applications.

SAP Service Cloud

SAP Service Cloud covers two service scenarios: field service and customer service (an office-based delivery model). Both scenarios are underpinned by standard integration to SAP S/4HANA and SAP ERP for master data (products, customers, service engineers) and transactional data (service contracts, service orders, time booking). The solution also includes integrated analytics to highlight valuable insight, such as ticket throughput, service-level agreement (SLA) breaches, and root-cause analysis.

SAP Field Service Management is for firms that operate teams of service engineers fixing issues at customer sites. At the core of the solution is service order management functionality that enables demands from customers to be recorded, including the detailed nature of the request. A basic resource scheduling application sits alongside the service order management component and manages the supply side of the process to ensure that each customer service order has an appropriately qualified engineer allocated while considering SLAs or customer deadlines that might exist.

Built on the SAP Cloud for Customer platform, the SAP Field Service Management solution benefits from many of the core features, such as integrated analytics, standard integration with SAP ERP solutions (where many customers were already

running customer service processes), and, critically, an ability to run the solution on mobile devices in an online/offline state.

The solution supports planned and reactive maintenance scenarios, as follows (we'll discuss these in more depth in Chapter 7):

- **Planned maintenance**
  This is used when a predefined maintenance schedule exists for a piece of equipment; your car is an example of equipment with a planned maintenance schedule.
- **Reactive maintenance**
  This deals with ad hoc requests from customers for service; if your car gets a puncture, calling the local tire shop is an example of reactive maintenance.

In both cases, the standard process provides support for ordering and consuming the parts required to complete a fix and for the service engineer to book time against the job. This process is heavily integrated into SAP S/4HANA and SAP ERP because those applications will manage the back-office processes (supply chain, procurement, material requirements planning [MRP], and billing) required to complete this process.

The SAP Service Cloud is designed to support office-based customer service departments and field service teams. It's important to stress that this wasn't designed to support high-volume contact center scenarios dealing with thousands of individual customer service issues per day—we'll come back to this requirement later in this section.

The scenario is built around a central service ticket concept that captures a customer request for service. A key capability of the solution is its out-of-the-box support for multiple customer service channels. The solution supports email, telephony, webchat, and social integration.

The social channel is of particular relevance in B2C scenarios with the increasing use of this channel by consumers. The solution can be connected with major social platforms; for example, with Twitter, relevant tweets can be collected and analyzed, followed by looking up a customer record, creating a service ticket, and placing it in a prioritized queue for an agent to work on.

Digital Disrupter

SAP is increasingly incorporating AI into these channel-specific service-ticket processes, allowing a greater degree of automation in the end-to-end process, reducing the need for human involvement in every ticket. The AI use cases include more accurately logging tickets through the automated creation process, automatically proposing answers to customer questions without human intervention, and predicting customer demand for reactive service before the customer is aware that assistance is required (see Figure 1.6).

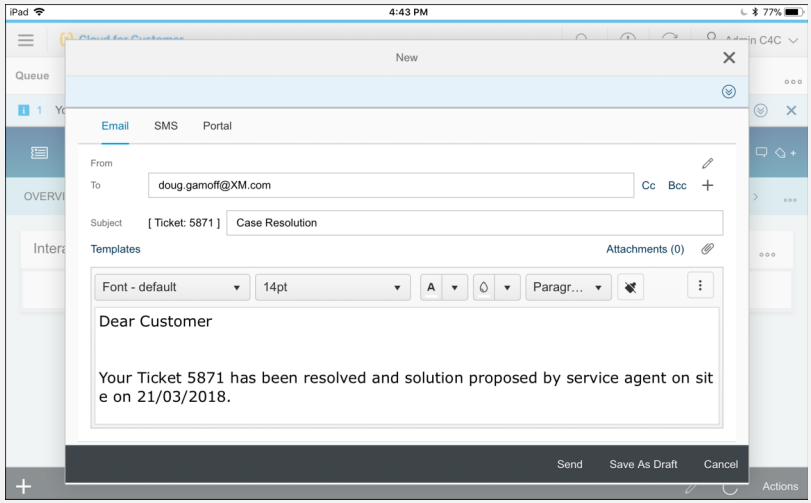

Figure 1.6 An Automatically Prepared Email by SAP Service Cloud Ready for Review and Sending by an Agent

The entire solution is designed to operate in a self-service model, providing greater convenience to the customer and allowing firms to reduce human involvement in simple issues that don't require it. A key element of the self-service solution is knowledge management, which enables a pool of information to be created in the form of questions and answers, built up by customer service employees to accelerate the resolution of customer service tickets. It's possible to expose this resource externally, via self-service, to customers who can then resolve problems themselves.

Integrated into the solution is a collaboration framework, which allows employees to share information and experience with each other and to work on individual customer service issues together to speed up resolution time and leverage the collective experience of the entire team.

SAP Customer Engagement Center

The SAP Customer Engagement Center supports high-volume customer service contact center scenarios, where firms might have millions of customers and are dealing with thousands of tickets per day; common examples of industries that use this are utilities and consumer telecommunications. Despite SAP Cloud for Service offering computer telephony integration (CTI) and email integration, the solution wasn't optimized for agents working in high-volume environments, where they might be processing multiple tickets simultaneously through a range of channels.

SAP Customer Engagement Center provides the underlying infrastructure and scaling required to deliver applications like this. It provides a unified agent desktop that acts as an agent's single point of access for all the tools and applications required to effectively deal with customer service issues. This includes interaction, ticket and order management, knowledge management, and a customer 360 view. The solution is integrated into SAP Jam to provide the collaboration capabilities that allow agents to leverage the insight and experience of their peers to resolve tickets quickly.

We discussed earlier how customers are adopting new technologies and channels in service requests. The solution supports the following channels: phone, email, text chat, video chat, voice, and mobile. There is a skills-based routing capability and a self-service option to expose the solution and its underling processes to customers directly.

1.6 Data

We're living through a period of change the pace of which is unprecedented. The advance of digital technology has changed the lives, behavior, and expectations of billions of individuals in just a few years. Customers and consumers are no longer anonymous individuals with no voice. We're a noisy collective who talk, share, switch, complain, and demand more, in an instant.

As consumers, we adopt and exploit new technologies at a pace that the brands and suppliers we deal with have been unable to match. Recent history is littered with organizations who were unwilling to listen or unable to act on what was happening around them; equally there are those organizations that have gone from zero to nine-digit dollar valuations in similar timescales.

Against this backdrop, any business dealing with consumers needs an intimate knowledge of them as individuals, which means understanding their past, knowing

them in the present, and predicting their future needs and behaviors. This intimate knowledge comes from customer data.

Data is now a strategic priority for firms looking to create differentiated CXs and in turn to stand out from their competitors.

In this section, we'll review the challenges with data and how the SAP Customer Data Cloud can address them.

1.6.1 Challenges in Data

Many challenges are associated with managing customer data and using it in customer-facing processes and applications. The volume of customer data available today is enormous, fueled by the increasing range of technologies that customers use to interact with the firms they buy from. To be useful to the firm (and therefore the customer), this data must be collected, structured, and stored. Much of this data will come from external sources, often on a paid-for basis, so determining which data is valuable and necessary is important. Because most CX programs still include a single customer view as part of their core objectives, many firms are further away from this vision than they were 20 years ago as they struggle to keep up with the explosion of data and the new types of data, including unstructured information such as video and voice.

In purchasing and storing data, the firm becomes liable for the responsible management of this information. There is a growing trend of regulation to protect customers and consumers from irresponsible firms who use this data inappropriately. Customers must now opt in and consent to their data being used, rather than the unreliable opt-out models of the past.

1.6.2 SAP Customer Data Cloud

The SAP Customer Data Cloud was created with SAP's acquisition of Gigya in 2017. This was SAP's first CX data acquisition and is unlikely to be the last. With this purchase, SAP acquired a suite of customer data technologies as well as huge amounts of customer data.

The SAP Customer Data Cloud is made up of three key components:

- **SAP Customer Profile**
  This component helps firms build their single customer view by creating a centralized customer profile drawing information from multiple sources and systems.

This profile can then be used in processes such as marketing segmentation to personalize targeted marketing or in customer service complaint handling to allow the agent to offer a more relevant, valuable level of service.

- **SAP Customer Consent**
  Helps firms implement strategies that deal with customer data privacy and to comply with regulatory initiatives such as GDPR in the EU. Customers are able to manage their own data and specify whether a firm is allowed to use their data.
- **SAP Customer Identity**
  Helps customers access a firm's website, mobile apps, and any other channel that the customer chooses to interact on. This sign-in process can take place without the traditional user/password inputs. The primary objectives here are to make the CX slick and to eliminate fraud through impersonation.

Through this solution, additional customer data is generated, which, in turn, can be passed into the customer profile managed through SAP Customer Profile.

1.7 The Road Ahead

SAP continues to invest heavily in its CX suite, which supports the view that this is a strategic priority for them. Their road ahead does pose some interesting challenges, particularly if their publicly stated aim of becoming #1 in CX software is to be realized.

First, Salesforce is currently #1 in CX by most analysts' measures and continues to demonstrate strong year-on-year growth, which many said they could not sustain. Many of the SAP ERP installed bases run Salesforce for major CX applications, and SAP's challenge, if they are to become #1, is to oust Salesforce from their core accounts. Salesforce was historically selected for its cloud-first model, references, and breadth of features. SAP is pushing hard on these points. SAP C/4HANA is a cloud-first suite, and SAP is acquiring competitors to gain more customers and capability. This leads to the second challenge, integration.

In 2018 alone, SAP purchased Gigya, Callidus Cloud, and Coresystems, which were all large businesses in their own right. The integration challenge for SAP isn't just technical integration but organizational integration. To benefit from these acquisitions, SAP needs to successfully embed the people and culture of their new acquisitions into their core activities and operations. There is also a technical integration challenge because these acquisitions are built on different platforms and in different

technologies to core SAP applications, so integrating and aligning them will require careful consideration. SAP customers expect their applications to integrate out of the box—it's part of what SAP has always been famous for—so there is work to do here.

There is then the impact on SAP customers themselves. A bewildering range of SAP CX applications are available, and often several applications perform the same role. SAP has to make sure customers understand its value proposition and strategy in CX; considering the branding changes, this has caused some confusion.

Data represents a further challenge. We've seen SAP acquire Gigya, as much for its customer data as for the social login product itself. For all the talk of AI being embedded into CX, AI can't exist without huge volumes of data to fuel it. Data now holds the key to unlocking value for the next generation of CX products, and software vendors will need to find a way of accessing or acquiring this data if their products are to deliver successful outcomes to their customers.

Finally, billing remains a confusing area of the SAP product set, in particular where the various products and applications sit within the SAP C/4HANA and SAP S/4HANA product suites. When SAP C/4HANA was initially launched, it included some functionality from the former SAP Hybris Billing. SAP Hybris Revenue Cloud functionality was later moved under the SAP Sales Cloud product within SAP C/4HANA where it's currently positioned. We expect further changes from SAP to the presentation and positioning of billing within the SAP C/4HANA and SAP S/4HANA product suites, so this is a space to watch. To keep things simple, we've positioned billing in Chapter 2, so we'll get into the detail there.

While SAP undoubtedly faces some challenges ahead, it has arguably never been better placed to capitalize on the opportunities in front of it. The acquisitions over recent years now mean SAP has a highly credible product set in all major areas of CX and a much larger installed base of customers to work with. The strength of the underling SAP HANA platform to deal with large volumes of complex customer data puts SAP at a strong advantage against some of its competitors in the market. In addition, through the SAP Cloud Platform, there is opportunity to leverage technologies such as AI and IoT to create new intelligence and capability in the next generation of applications.

Now that we've reviewed CX and what is possible with the SAP C/4HANA suite, in our next chapter, we'll examine the CX capabilities of SAP S/4HANA.

Chapter 2
Sales and Service with SAP S/4HANA

We've explored customer experience with SAP's new SAP C/4HANA solution. Now, let's pivot towards sales and service, focusing on SAP S/4HANA and the differences between these offerings.

In the previous chapter, we looked at customer experience (CX) with SAP C/4HANA. SAP C/4HANA is SAP's dedicated product suite for CX, but there is more to the SAP CX offering than SAP C/4HANA.

SAP has been providing customer-facing processes and features to its customers for almost as long as it has been in business. SAP R/2 and R/3 ERP products included the Sales and Distribution (SD) module, which provided flexible order-to-cash, sales forecasting, customer service, and logistics execution solutions, used in a business-to-employee (B2E) capacity. The SD module is one of the most widely implemented (and customized) SAP ERP modules; for many firms, it's a vital element of their commercial IT landscape.

Today, with SAP S/4HANA, SAP continues to offer and develop customer-facing business processes through an entirely separate platform to SAP C/4HANA, which continues to create confusion with the SAP installed base, prospects, and consultants.

SAP's strategy here isn't to offer two solutions for every CX problem or domain, but there are areas of overlap. All four of the main areas we cover in this chapter are offered in some capacity in SAP C/4HANA.

These areas continue to be offered in SAP S/4HANA partly because they have always been available to SAP customers through this route but also because they integrate with, depend on, and enrich other SAP S/4HANA business processes and their associated data. It's not possible to provide an order management capability without the ability to check inventory in a warehouse or post to General Ledger (G/L) accounts.

Today, there are opportunities to use these processes and data in new ways. Where previously technology inhibited this and only made it possible to expose these processes to well-trained employees, it's now possible to expose parts of the

order-to-cash process directly to customers and to engage partners in collaborative sales forecasting processes.

SAP continues to provide standard integration and end-to-end business scenarios and processes that leverage the power of both product suites. Many of the SAP C/4HANA applications, such as SAP Sales Cloud, draw information directly from SAP S/4HANA to create a single view of the customer, eliminating the information siloes that have historically existed.

In this chapter, we'll clarify exactly what customer-facing processes are supported in SAP S/4HANA and explain the differences with SAP C/4HANA.

There are four main areas that represent the customer-facing part of SAP S/4HANA:

- **Order and contract management**
  This area is used to capture customer demand and provide all associated features, such as pricing, credit management, and availability.
- **Sales planning and performance management**
  This area is used to help firms create, manage, and improve their sales forecasting process as part of a wider business forecast.
- **Revenue, billing, and invoicing**
  This area involves the critical processes of charging customers for goods and services provided and the associated capabilities.
- **Customer service**
  This area is used to deal with customer requests post-sale for repairs and maintenance, as well as to deal with inquiry and complaint processes.

We'll begin with a business case to place some of these topics into context, before looking at each of these topics in turn and concluding with the future of this area for SAP and its customers.

2.1 Business Case

We set out a number of commercial priorities and objectives for Bault Robotical at the beginning of Chapter 1: deliver 20% year-on-year revenue growth, improve CX and become more customer-centric, and improve employee engagement by equipping them with the right tools. Let's revisit these objectives from an SAP S/4HANA perspective, starting first with the existing commercial IT landscape.

At the core of the commercial IT landscape was an SAP ERP 6 system that had started life over 10 years ago. During this time, it had been through several major upgrades and had been heavily customized and modified to cover every commercial practice and process that the firm had ever offered. The solution worked, but it was becoming increasingly costly and painful to maintain, particularly when upgrades were required. Certain new features included in new releases couldn't be deployed as they were incompatible with the extensive modifications made to core functionality.

As Bault Robotical sought to expose the order-to-cash process through new channels, it had come to realize that this platform could no longer deal with the demands being placed on it.

Innovation projects around pricing and an app that allowed customers to check prices and place orders had stalled as the IT department was unable to deliver the work on this backend system quickly, and the aging technology was incompatible with some of the newer web and mobile technology platforms selected.

New employees joining the company were consistent in their feedback. The ERP system was difficult to use, not intuitive, slow, and clunky. At least two employees who resigned from the telesales department named this system as one of their reasons for moving on.

Bault Robotical needed a new ERP platform that could deliver on the following objectives:

- A software-as-a-source (SaaS) solution that would provide regular releases of new features that helped them to implement new business processes and models
- A means to return their core business application to a more standard solution that reduced complexity and cost
- A way to expose previously internal customer processes and data through new channels and technologies
- A platform that would provide a basis from which to run innovation projects that helped the business realize its strategic priorities
- A way of increasing the efficiency of internal processes and reducing staff attrition attributed to legacy systems' usability and capability

To achieve these objectives, an SAP S/4HANA project was launched that included order-to-cash in the first phase.

During the initial blueprint, a complete review of business processes and requirements was undertaken to determine core requirements. Included as part of this work

was an in-depth analysis of current pricing and promotional strategy, which reduced the 100 or so different pricing elements used in the old system down to just 20.

The upcoming projects around commerce and the customer mobile app were raised, and the design of the solution considered that parts of it would be directly visible to external parties. Data that couldn't be exposed to customers was clearly identified and marked as such up front.

Employees from the telesales team were directly involved with the project and provided feedback on the old system regarding what made it difficult to use and how it negatively impacted the customer. They liked the new SAP Fiori user interface (UI), which pulled together the information they needed to take an order in once place and automated steps of the process. This reduced the time taken to create an order and shortened average call handle times in the telesales team.

As part of Bault Robotical's adoption of new business models, the firm was now offering a "robot-as-a-service" where the customer was charged based on the number of hours the robot was in operation. This required features from SAP S/4HANA for billing and revenue innovation management, which allowed the usage data to be imported, charges calculated, and invoices raised.

2.2 Order and Contract Management

In this section, we'll look specifically at the process of capturing and processing orders and the role that the contract can play in supporting this. We'll look at some of the basic business models that are supported, the increasing importance of business networks in order management, and some of the key components that collectively make up order management.

The importance of sales to firms is well understood, however, the physical process of capturing and recording the sale is often a distraction to a salesperson and a cost to the firm. Consider a common scenario in which a sales rep has a 1-hour meeting with a customer once a month. The customer typically orders 150 lines in their monthly order. If the rep can key 3 lines per minute, this leaves them with 10 minutes to build a rapport with the customer, share news of latest product launches, deal with issues, cross-sell, up-sell, and all the other important tasks they should focus on.

For this reason, most firms have a set of common requirements in relation to order and contract management:

- The process of capturing an order must be simple and efficient to minimize the time and effort associated with the task.
- Automation should be incorporated where possible to eliminate repetitive manual tasks.
- Customer demand must be captured accurately because mistakes are time-consuming and costly.
- Orders must be captured and processed consistently irrespective of which channel they are received by or who created the order.
- The core order management solution should be flexible and exposed to different audiences, so that customers can create their own orders (e-commerce), field sales reps can create orders on mobile devices and other devices, and applications can create orders (a business network/Internet of Things [IoT] scenario).

In the following sections, we'll go over the general order and contract management process, before getting into the relevant SAP S/4HANA tools.

2.2.1 Process Steps

Order and contract management can be thought of as a connected set of components:

1. **Inquiry**
   The inquiry is used to capture a potential order from a customer, who will typically require information about availability, price, or other details. At this stage, there is no commitment from either party to proceed at this stage.
2. **Quotation**
   The quotation is used to provide an offer to a customer for the delivery of goods or services and represents a formal offer that can be legally binding depending on local law and the associated terms and conditions. A price is typically calculated as part of the quotation process, based on an agreed quantity of goods or services and date by which these will be provided. The customer is under no obligation to accept or proceed with this quotation. The quotation will normally be valid for a limited period of time.
3. **Order**
   The order is the capture of confirmed demand from the customer. It's the basis by which demand is passed into the supply side of the business and final prices determined (if these have been previously determined at the quotation stage, they should be honored unless the quotation has expired).

It's common practice to copy information from the preceding document into the new document and adjust it as required. At any point in this process, the contract may be set up or referenced. A customer may want to determine the price for a potential new order based on a recent contract that has been put in place, or a contract might have specific terms about minimum order quantities that need to be respected when a quotation is raised.

4. **Contract**
   The contract represents an agreement between customer and supplier and describes a set of terms and conditions that both parties agree to. These might cover preferential pricing, a volume-based agreement, or any other aspect of the commercial arrangement between the two parties. The purpose of the contract is to allow these terms to be defined once, normally for a defined period, and to then ensure they apply to all order-to-cash transactions during the contract's lifetime.

2.2.2 Business Models

Order and contract management can be fundamentally different depending on the industry in which a firm operates. Let's look at two of the main relevant business models when considering order and contract management:

- **Make-to-stock (MTS)**
  MTS is used when firms produce the same product over and over again. Cans of beer, TVs and this book are examples of MTS items. In this situation, the firm will have inventory (stock that *is* in a warehouse) and an inventory forecast (stock that *will be* in the warehouse based on a current plan). The firm will plan very carefully what it needs to produce (including how much), but the company won't wait to receive a customer order before it manufactures or procures.

  When a new order is created, current and planned inventory levels can be checked to determine availability dates, and then this stock can be allocated to the customer order.

- **Make-to-order (MTO)**
  MTO is used when firms produce unique products for each customer order. There is a direct link between each sales order and a production order.

A common example of a MTO item is a new family car. A new car will have millions of possible combinations such as engine size, seats, wheels, color, and transmission. When a customer places an order for a new car, the customer must specify these options, resulting in an order being sent to the factory production line.

We'll discuss these models, as well as a few more, to greater extent in the context of manufacturing in Chapter 5.

2.2.3 Product-as-a-Service

Many firms are redefining how they sell to their customers by switching from a product-based offering to product-as-a-service (PaaS) models. With classic product-based businesses, a physical good is sold to the customer, and at the point of purchase, ownership of the good is transferred to the customer. This business model is simple and well understood but does create challenges for both parties. The common challenges with the product-based model are as follows:

- There are limited incentives for the supplier to produce goods with a long operating life because when the product fails, there is a chance to sell a replacement.
- When the customer owns the good (or asset), the customer may only need to use it for some of the time, yet they are paying to own it all of the time.
- The purchase, particularly of large items, requires significant capital to be made available, which can cause financial challenges, such as cash flow shortages, to the customer (and the supplier).

In a world and global economy where resources are ever more scarce there is a need for greater efficiency. The classic product-based model does introduce inefficiency for some of the preceding reasons.

In an attempt to resolve these problems, firms have started to rethink their entire strategy around customer delivery. The essence of PaaS is to think about the delivery of value to the customer, rather than the delivery of a physical good. Instead of having to purchase and own a good, customers rent or lease access to a product and is charged according to their usage.

Consider the car-sharing firms that now allow customers to own a vehicle for a predefined amount of time or to use the car for a certain amount of miles. There are examples of this in B2B; for example, many airlines now rent aircraft engines from manufacturers rather than purchase them.

PaaS brings a number of benefits to suppliers, customers, and the broader economy:

- There is an incentive for suppliers to produce products that last longer, reducing waste and inefficiency.
- Customers only pay for the product based on their usage of it, which reduces their costs.
- Goods can be shared by customers, which means fewer physical units need to be produced, and the units produced are used more completely and efficiently.
- Customers can spread payment evenly over time, which eliminates the need to find large sums of capital for one-off purchases. Suppliers receive a more balanced income, and, based on contracts, they are able to forecast with greater certainty.

PaaS is clearly not suitable for all industries, but for many firms, it has transformed their outlook and success. The shift to this model impacts order and contract management, as well as billing and revenue management. There is a greater emphasis on contracts rather than orders, where the exact nature of the agreement needs to be recorded, including the basis by which the customer will be charged. This then creates a need for data because charging is normally based on consumption or usage and that may not be readily available to the supplying firm.

2.2.4 Business Networks and Order Channels

Historically, customers have placed orders via a sales representative or through a customer service advisor. Today, in business-to-business (B2B) and business-to-consumer (B2C) scenarios, firms encourage customers to place their own orders to reduce costs and offer greater convenience to customers.

E-commerce isn't a core capability of SAP S/4HANA although the order management component of SAP S/4HANA does underpin large parts of a commerce platform (data, pricing, availability, and requirements) transfer.

What's Right for You?

For firms considering a new commerce platform, there are several choices, including the SAP Commerce Cloud, various SAP partners who offer certified integration of their commerce product to SAP S/4HANA, and, of course, development of a commerce platform and integration with SAP S/4HANA.

Which option is right for your business will depend on a number of factors:

- **Breadth of functional scope**
  If you have a long list of complex requirements relating to commerce, you'll lean toward an existing product such as SAP Commerce Cloud. If your requirements are relatively simple, you may not need a heavyweight commerce product with all of the expense that entails.
- **Business criticality**
  If your commerce platform is a mission-critical asset of your business, then you need to have confidence that it can scale, is robust, and is keeping up with consumer technology trends. In this scenario, a home-developed commerce site is unlikely to make sense.
- **In-house IT department**
  If you intend to build and run your own solution, you'll need to recruit and retain a specialist team with web development skills. If this doesn't fit with your IT strategy, you should consider purchasing SAP Commerce Cloud to reduce your in-house resource requirements.
- **Industry-specific requirements**
  In certain cases, SAP partners have developed specialist solutions that deal with the unique processes and requirements of an industry. If your business has certain industry-specific requirements that aren't available in SAP Commerce Cloud, you might find a partner solution that can bridge the gap.

The role of field sales teams is changing too. Historically, reps have been incentivized through volume or profit figures, which encourages them to sell as much as they can to the customer. Forward-thinking firms are now moving away from this transactional focus to a more collaborative business model where the rep becomes an advisor and coach to the customer (as well as a seller).

For orders created by sales reps working in the field, SAP S/4HANA offers some limited capability. Because the UI is delivered through SAP Fiori, it's possible to create an order using a tablet or smartphone with a browser running the SAP Fiori app.

This is simply an order input tool, however, and doesn't provide many of the other tools and information that the rep requires to operate in this new collaborative capacity. Firms looking to provide a more holistic set of capabilities to their field sales forces will typically look at the SAP Sales Cloud to meet these specific requirements.

In B2B, there is now a shift toward business networks, where smart devices and business applications can automatically order on behalf of the firm and its employees.

This eliminates the cost of human intervention, reduces the scope for someone forgetting to create an order, and helps to avoid customers running out of what they need. In retail, supermarket chains use demand-sensing technology that includes electronic point of sale (EPOS) systems that scan data (what the shopper purchased at the store), current stock, weather, and calendar data to predict demand for each product and then automatically order based on this prediction.

SAP S/4HANA used in combination with the SAP Cloud Platform allows firms to expose their order management core to external applications, such as commerce platforms. Where those external applications are delivered by SAP, standard integration is normally provided.

2.2.5 Order and Contract Management with SAP S/4HANA

The order and contract management functionality in SAP S/4HANA is based on a set of connected documents that reflect the full order-to-cash process with information copied from one document to the next at key stages in the process.

What's Right for You?

Order and contract management is a capability that SAP offers through both the SAP C/4HANA and SAP S/4HANA product sets, leading to questions about which is best. This will depend on the unique requirements of your project.

Order and contract management in SAP C/4HANA couldn't operate as a standalone solution for most firms. The downstream processing that takes place after an order is created includes finance, production, logistics, and credit processes, and none of these exist natively in SAP C/4HANA. For this reason, the order will typically need to be replicated back to an ERP system (SAP provides standard integration to SAP ERP and SAP S/4HANA for this reason).

Firms that choose to deploy order and contract management through the SAP C/4HANA suite often do so for the following reasons:

- They are deploying the solution to a field sales force who need the ability to capture and price orders when the device is in a disconnected state.
- They need a solution that focuses on the extended presales process in areas such as opportunity management and lead management.
- They are deploying a B2C e-commerce solution and need the latest features and functions associated with that domain.

- They operate a high-volume contact center that provides sales and service functions to customers, often in the same call.
- There is an emphasis on bringing the marketing and sales functions together more closely and a desire to attribute sales to marketing activity more reliably.

In all of these scenarios, the order will still need to be passed to an ERP system for fulfillment, financial postings, transfer of requirements, and invoicing.

If your project doesn't have any of these requirements, then it's perfectly valid to deploy order and contract management through SAP S/4HANA alone. If you need to take advantage of native SAP C/4HANA features later, you can always connect SAP C/4HANA applications to your SAP S/4HANA core.

Let's take a look at the order-to-cash process, as shown in Figure 2.1.

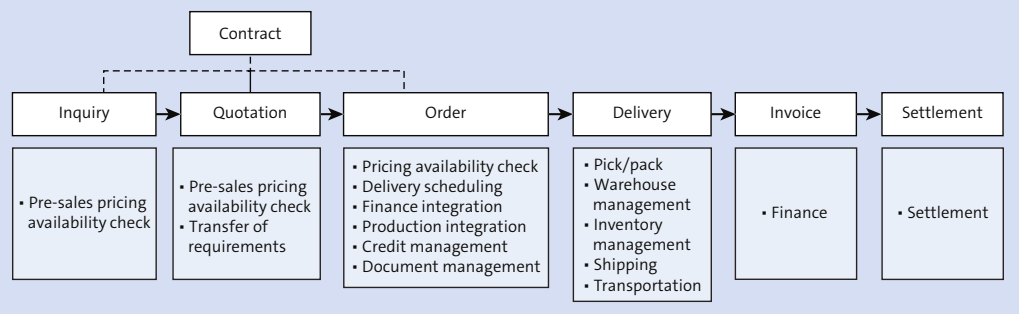

Figure 2.1 The Order-to-Cash Process

The inquiry and quotation documents, which we discussed earlier, are optional. The order is the document that captures committed customer demand in the system and provides the basis by which dependent processes and processing are triggered.

The main features and functions available in SAP S/4HANA order and contract management are as follows:

- **Presales**
  This is the capability to support activities leading up to and helping to secure a sale, including lead and opportunity management.
- **Pricing**
  This is the core engine that allows businesses to represent their pricing model in SAP, including promotional discounts, contractual discounts, surcharges, and sales taxes.

- **Product configuration**
  For MTO businesses, this is the facility that allows each order to be specified with the precise set of requirements and options that the customer requested.
- **Availability checking**
  For MTS businesses, this is the facility that performs a check to determine whether sufficient stock is available to satisfy a customer order or confirm when the required stock will be available based on a forecast.
- **Transfer of requirements**
  This provides the link between sales and the supply chain by presenting confirmed customer orders to planning and forecasting tools, such as material requirements planning (MRP), to ensure the customer requirement is met.
- **Credit management**
  This facility is used to manage the firm's exposure to risk from providing bad credit by managing the credit provided to customers and helping with the recovery of debt.
- **Delivery management**
  This deals with the process of picking, packing, dispatching, and transporting goods to customers.
- **Finance integration**
  This is the integration between order management and finance, including invoicing and G/L account posting.
- **Document management**
  This is the process of generating physical and electronic documentation.

To help you understand some of the key differences between the SAP C/4HANA and SAP S/4HANA options here, Table 2.1 provides a comparison of key features by product.

Feature	SAP C/4HANA	SAP S/4HANA
Presales	Extensive support around inquiry, quotation, and opportunity management, including sales pipeline management.	No dedicated lead or opportunity management capability Transactional processing of quotes and inquiries.

Table 2.1 Order and Contract Management Features in SAP C/4HANA and SAP S/4HANA

Feature	SAP C/4HANA	SAP S/4HANA
Pricing	Capable of using SAP ERP or SAP S/4HANA pricing model through a service call or via extraction of data and configuration. Limited ability to price offline.	Full pricing model based on condition technique with extensive flexibility and integration into SAP S/4HANA Finance via G/L account posting. No offline solution currently.
Product configuration	Product configuration available via SAP Sales Cloud and SAP Commerce Cloud using extracted configuration, data, and model from SAP S/4HANA or SAP ERP.	Native product configuration capability.
Availability checking	Calls to SAP ERP or SAP S/4HANA to determine stock availability.	Available-to-promise (ATP) using SAP HANA-based advanced available-to-promise (aATP) allowing complex strategies for product allocation against customers.
Transfer of requirements	Demand captured in SAP C/4HANA sales orders passed back to SAP ERP or SAP S/4HANA as a sales order to present it into the supply side of the business process for manufacturing or procurement.	Direct integration into production and procurement via MRP, including support for scenarios such as third-party direct ship.
Credit management	Integration to SAP ERP or credit management functionality in SAP S/4HANA via service calls.	Direct access to SAP Credit Management functionality.
Delivery management	No concept of a delivery document in SAP C/4HANA although information about the delivery status of an order can be retrieved from SAP ERP or SAP S/4HANA.	Full integration to delivery management as part of logistics execution (LE) with support for pick, pack, dispatch, proof of delivery (POD), and returns scenarios.

Table 2.1 Order and Contract Management Features in SAP C/4HANA and SAP S/4HANA (Cont.)

Feature	SAP C/4HANA	SAP S/4HANA
Finance integration	SAP C/4HANA billing a separate application, which can be used to invoice sales orders. Integration still required to central finance system for clearing, settlement, posting, and so on.	Native integration into invoicing via single order-to-cash process.
Document management	Standard supported feature.	Standard supported feature.

Table 2.1 Order and Contract Management Features in SAP C/4HANA and SAP S/4HANA (Cont.)

2.3 Sales Planning and Performance Management

SAP markets and sells sales planning and performance management as a single suite of capabilities; under the covers, SAP draws on individual applications and features from both SAP C/4HANA and SAP S/4HANA. Here, we'll focus on SAP S/4HANA's sales planning and performance management functionality elements as follows:

- Incentive and commission management
- Sales planning and monitoring
- Sales monitoring and analytics

Sales forecasting applications are able to address these areas by deploying a single, consistent planning application to the individuals involved in the process. Technology is also providing new capabilities through the application of data science and predictive modeling. This capability shifts the onus from human decision-making and perception to machine-based algorithms that can continuously learn and improve, ultimately providing more accurate forecasts.

Advances in technology now allow forecasts to be built and calculated at much lower levels of granularity. For businesses that need to forecast by product and day, there are now applications designed to exploit these new technologies to provide more detail, to carry out more calculations, and to deliver the results in real time, allowing what-if modeling and iterative planning processes to take place.

To build, train, and run these predictive models, data is required; it's the fuel on which they run. There are many new sources of data available both within and outside firms.

Firms are now embracing their partners and customers through business networks, partly to find and secure new sources of data with which to forecast sales more accurately. In principle, this is in everyone's interest. Customers sharing their data with suppliers helps suppliers avoid out-of-stock and to over-supply scenarios, which can be passed on to the customer in the form of higher prices. Suppliers also want to know the likely demand on their goods and services for the same reason.

Business networks aren't just about sharing data. Collaborative planning models now connect key stakeholders, with each bringing different experience, insight, and perspective to the process. By bringing all key groups into the forecasting process, there is less risk that one firm or party acts in a way that compromises the forecast, and there is a collective focus on delivering against it.

Now, let's explore the business processes, and see the various SAP technologies in action.

2.3.1 Incentive and Commission Management

How firms effectively incentivize their sales teams is a complex subject area. As businesses seek to transition the basis of their relationship from classic supplier–customer to long-term value-based partnerships, the role of sales professionals is changing. Previously, sales professionals were incentivized to generate as much revenue (and often profit) as they could, which encouraged a short-term outlook. As firms now seek longer-term relationships, it requires a rethink of how sales professionals are incentivized and rewarded for their outputs because a simple revenue or profit target may not be enough to deliver the long-term strategic objective of the firm.

Many firms are currently examining how they can be more agile to effectively deal with increasingly dynamic markets, new entrants, and changing customer needs. This agility must allow firms to execute strategic and operational changes quickly and effectively, particularly in the commercial division. Changing the sales and marketing strategy midyear and then executing this change with the sales force will require flexible incentives and commission structures.

SAP S/4HANA Sales for incentive and commission management provides a means to model, create, approve, and manage variable commission plans for sales teams. The

solution is based around a defined set of master data that includes the organizational structure of the firm, employees representing sales professionals, and customers.

Commission plans are built as a set of rules that exist within a contract and are then run through a review-and-approve process before being stored and exposed to a calculation engine.

As the order-to-cash process runs in SAP S/4HANA, data is generated that is passed to the calculation engine to determine the commission payment based on the defined rules; the solution integrates into the finance functionality to deal with the payment and associated G/L postings.

2.3.2 Sales Forecasting

The sales forecast is a vital tool in the operational and strategic decision-making of any firm. The ability to accurately predict which goods and services you'll sell, in which quantities, and at what price allows leaders to make informed decisions about how to move the firm forward.

The modern marketplaces in which firms operate are volatile and becoming increasingly so. Technology is removing barriers to entry that historically existed, new business models are disrupting established industries, and customers are better informed and switch more quickly as a result of this. In this environment, traditional methods of planning become less effective, the accuracy of the forecast is reduced, and the quality of decision-making is compromised.

Historically, sales forecasting has been an offline process run on spreadsheets. Each member of the sales team would create their own local forecast and submit this to a central team who would then aggregate, reformat, and present the data. The results would be reviewed by the finance department members who inevitably had questions that would be relayed back to the sales team, resulting in a round of adjustments being made to the forecast. This process was time-consuming and labor intensive; for many firms, by the time the final forecast was produced, it was out of date and inaccurate.

Many firms are challenged by the concept of "one number," that is, a sales forecast, which is aligned to a production forecast and a financial forecast. It's not uncommon for find three different sets of plans and numbers for what is essentially the same set of information. There can be several reasons for this, but often, the problem starts

with the question of ownership. Which team or department owns the volume forecast (i.e., how many of each product will the company manufacture and sell)? Should it be the sales team, who deal with customers every day and are arguably closest to the source of demand from which everything is determined? Should it be the marketing team who take a long-term of view of trends, patterns, and their impact on customer demand? Or should it be production because they will ultimately determine how much is produced (and therefore sold)?.

The answer to this question is all of them. Each department brings a specific set of skills and insights to the planning and forecasting process, and it's important that everyone is aligned around a common plan for the business to move forward with confidence. SAP offers a more extensive solution for business-wide forecasting (see Chapter 3 to learn more about this). SAP S/4HANA sales forecasting isn't a business-wide application, so the challenge of one number needs to be considered in any implementation.

There are two main components of the sales planning solution in SAP S/4HANA. The first, Manage Sales Plan, is an SAP Fiori app that allows sales teams to create, change, display, and publish (release) their sales plans using a basic planning grid of rows and columns.

The layout will incorporate three types of data:

- Characteristics to represent master data such as product and customer
- Key figures to represent information such as cost of goods sold (COGS) and revenue targets
- Time to represent the daily, weekly, monthly, and yearly buckets that can be planned against

The application can generate a Microsoft Excel template, allowing sales users to build their plan in Excel and then upload it back to SAP S/4HANA afterward. The solution also incorporates version management, basic status management, and the option to plan using ordered or invoiced sales volumes.

The second component is the SAP Fiori app called Sales Performance – Plan/Actual. This app takes the planning data from the first app and compares it to actual sales data using the order-to-cash transactional data generated in the order and contract management functionality we discussed earlier in this chapter.

It's now possible to understand performance against target and to flag where there are significant differences between the two. This information can then be used to feed into subsequent planning cycles to drive improved forecast accuracy.

2.3.3 Sales Analytics

In an age where digital disruption has put multinationals and market leaders out of business, the role of sales analytics has never been more important to help firms remain competitive and alive to the new threats they face.

Customers are changing in how they buy and what they expect, and they are leaving an ever-expanding footprint of data behind them as they do this. Somewhere buried in this data are valuable insights but firms are having to work increasingly hard to obtain, gain permission to use, analyze, and then use these insights to make a difference. If all of this data were to be made available to sales teams, they would be overwhelmed by it. So the challenge here is to generate meaningful insight from this wealth of information and then inject it at key points in business processes so it can be acted on. SAP S/4HANA includes a comprehensive set of sales analytics applications in two formats.

There are overview apps that draw together information from across the sales function, including MySales Overview and Sales Manager Overview. These are dashboard-style applications where each type of data (e.g., returns or quotations) is presented as a card with headline information, which can then be drilled through to reveal more detailed information.

The second type of app provides focused, detailed insight into a particular process step or document. These include the following:

- Quotation conversion rates
- Sales contract fulfillment rates
- Sales order analysis
- Incomplete sales documents
- Sales order items on backorder
- Delivery performance
- Sales volumes
- Order-to-cash performance

As these analytics applications are provided through the SAP Fiori UI, they can be run on desktop, tablet, and smartphone devices with optimized views for each form factor.

2.4 Billing and Revenue Management

In the digital age, the way that people and firms buy products and services has changed profoundly. The firms that provide these products and services are thinking differently about their value proposition to the market and how they monetize this.

A great recent example of this is the music industry. In a relatively short period, consumers have moved from purchasing albums outright in main-street stores to renting music via a streaming service and paying monthly. The success of recording artists is no longer measured by the number of albums purchased but by the number of tracks streamed. Classic music retail businesses that were unable to respond to these disruptions didn't survive.

Firms today face enormous pressure to adapt and innovate in their marketplaces or risk being put out of business if they are unable to. This involves thinking beyond the classic order-to-cash model and reconsidering how the product or service is provided, delivered, and paid for.

There are great opportunities for firms that can innovate and disrupt their marketplaces through technology. The music streaming industry didn't exist 20 years ago, but today it's a multibillion-dollar industry and the de facto choice for most people who want to access recorded music.

To create these new business models, firms need to be agile and consider how their internal sales, service, and revenue management teams collaborate together effectively to realize the change.

Billing and revenue management is a capability that SAP currently offers to some extent through both SAP S/4HANA and SAP C/4HANA. The SAP S/4HANA solution has its roots in the Sales and Distribution (SD) module, which is inherited from the previous SAP ERP product. SAP C/4HANA contains some functionality from the former SAP Hybris Billing, now reverted to its original name, SAP Billing and Revenue Innovation Management (SAP BRIM) and originally designed to support the billing requirements of the telecommunications, transportation, and utilities industries, but is now also used across other industries.

SAP's product strategy and road map around billing remains somewhat unclear with significant overlap between the various solutions, which is compounded by rebranding exercises. For the foreseeable future, this position is likely to remain, and we should expect to see billing available through both product suites as well as standalone options.

Digital Disrupter

The recent transition from firms providing physical products to providing subscription services that leverage usage-based models has added additional pressure on organizations to adopt new billing models and consequently adopt or reinvent their current billing and revenue management solutions.

Those firms who have made this switch have found their existing ERP platforms unsuitable for dealing with these new subscription models. New capabilities were required to recognize and measure consumption-based events and to provide accurate invoicing based on these. In addition, the need for agility in defining new billing models and charging structures and implementing them quickly without damaging the customer experience was challenging classic ERP billing solutions.

In the following sections, we'll take a look at the various billing and revenue management models, before unpacking the solution options.

2.4.1 Billing and Revenue Management Models

Let's take a look at some of the most commonly used billing models. Figure 2.2 shows four example ads that demonstrate the various ways to pay.

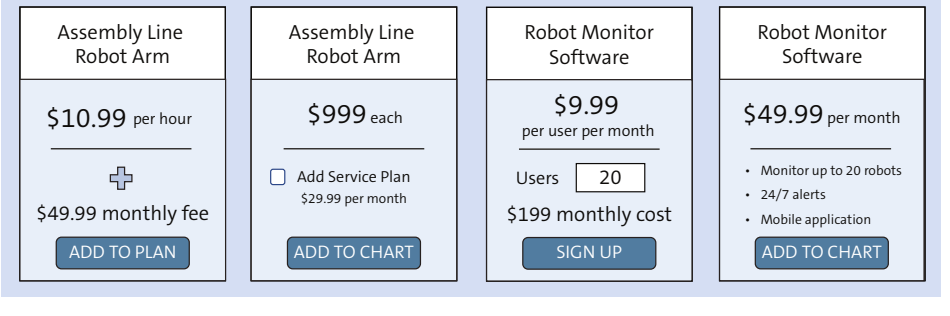

Figure 2.2 Example Billing Models

Let's look at some of the different billing models that firms use to realize revenue for their products:

- **Fixed recurring model**
  The fixed recurring model is a fixed price product that works on a subscription basis. Customers are charged on a recurring basis, typically at the beginning of the billing cycle, based on an agreed recurring price and billing cycle.

  The fixed recurring model includes the following benefits:

  – A recurring revenue stream for the firm
  – A low cost of entry for the customer and the ability to spread cost over time
  – Predictability for customers
  – An opportunity to market and up-sell products and services in future

- **One-time charge model**
  The one-time charge model includes the sale of a single product with a set of features at a single price. The one-time charge can be used for one-time products or services or as part of a subscription plan.

  The one-time charge model includes the following benefits:

  – Revenue realized early for the supplier
  – Easy-to-communicate flat rate price
  – Allows prospects to try the product or service before committing to a subscription
  – Ability to test demand for new products and services

- **Seat- or meter-based model**
  The seat or meter based model is used by subscription businesses that charge customers depending on their number of users or seats. This model is frequently used by firms selling software, where a monthly fee is charged per user on an agreed billing cycle basis.

  The seat- or meter-based model includes the following benefits:

  – Predictable costs
  – Scalable model
  – Transparent billing

- **Usage-based model**
  The usage-based model is used by subscription businesses that want to enable customers to pay only for what they use. Normally referred to as pay-as-you-go, this model directly relates the cost of a product to its usage: your bill will go up if you

use more of the service or go down if you use less of it. This model is commonly used by cloud-based services organizations because it's highly adaptable to market changes.

The usage-based model includes the following benefits:

- Highly adaptable to market conditions and competition
- Price alignment to the product value
- Reduces chance of churn
- Usage analysis to up-sell opportunities

2.4.2 Solution Options

Billing features are available through both the SAP S/4HANA and SAP C/4HANA product suites; however, as of fall 2018, the positioning within SAP C/4HANA is not entirely clear. Rather than directly flowing into SAP C/4HANA, SAP Hybris Billing has reverted to its original name, SAP BRIM, which is a standalone solution.

Billing as a capability of SAP S/4HANA has its roots in SAP's previous R/3 and SAP ERP products, where it was used to run the billing and accounting aspects of the order-to-cash process. It works particularly well when a customer or organization pays a fixed price for a product or service. It was also able to cover specific scenarios such as milestone billing, commonly used in the construction industry; resource-related billing used in MTO complex manufacturing scenarios; and intercompany billing used in cross-charging scenarios.

These core order-to-cash processes, still used by many organizations, are supported in SAP S/4HANA. This solution is referred to as *sales billing* and is positioned inside the sales functionality of SAP S/4HANA under order and contract management. It can be used to provide billing and related accounting features for use in nonconsumption-based models.

In addition, for consumption-based models, SAP S/4HANA for subscription billing with the sales and distribution option allows consumption-based data to be transferred from an external system (including SAP Convergent Invoicing) into SAP S/4HANA sales billing where the invoice can be created and the appropriate accounting entries posted.

The following features are delivered as standard in SAP S/4HANA when integrated with an external charging application:

- Invoicing for aggregated consumption data: Create invoices in SAP S/4HANA using accounts receivable (FI-AR) in sales and distribution (SD), from billing documents created in SAP Convergent Invoicing for them.
- Single or mass transfer of SAP Convergent Invoicing billing documents: Transfer single billing documents or large numbers of documents originating from SAP Convergent Invoicing to SD invoices.
- Partner settlement: Settle charges with the partner for the use of its products, services, infrastructure, and so on.
- Payment cards: Use payments cards to process payments for subscription- or consumption-related data coming from SAP Convergent Invoicing being invoiced with SD billing.
- Distributed scenario: Transfer SAP Convergent Invoicing billing documents from one or multiple systems to one SD system to create invoices.

SAP BRIM, meanwhile, provides more flexibility and agility to firms that are seeking to disrupt their marketplaces and to innovate in their product and service delivery models. The software is delivered in a modular form, for both B2C and B2B businesses, and can therefore offer full end-to-end revenue management processes or provide specific features and capabilities into existing systems and processes.

The components of SAP BRIM include the following:

- Subscription order management: This supports the creation of new product and services paid for on a subscription basis by the customer. It includes capabilities for targeted selling and the enrollment process.
- Mediation by DigitalRoute: This module allows firms to create and consolidate all the usage data required to feed into usage-based billing and pricing models. This solution is a third-party product sold by SAP on behalf of the vendor.
- Charging: This module provides support for designing, managing, and optimizing charging/pricing structures in both prepay and post-pay scenarios. The solution incorporates the flexibility to make quick changes to pricing models and immediately implement these into downstream billing and revenue management processes.
- Invoicing: This module is responsible for generating customer invoice documents for products and services. This includes the ability to consolidate billing items from multiple other systems into a single customer invoice. This solution will integrate with the subscription, mediation, and charging functionalities.

- SAP Digital Documents by OpenText: This solution deals with the generation of physical and digital outputs from the revenue management process, including the generation of invoice documents. This is a third-party product sold by SAP on behalf of OpenText.
- Customer financials: This functionality deals with the financial accounting processes and postings that are generated through the end-to-end revenue management process. This includes the capability to deal with collections management, credit management, and disputes management processes.

Let's revisit our models from the previous section through the lens of our two deployment options:

- **Fixed recurring model**
  This model is supported by both SAP S/4HANA and SAP BRIM solutions, but due to its nonconsumption-based nature, this would normally be implemented using SAP S/4HANA standard SD functionality. If a customer is offering this model in conjunction with other consumption-based models, then its implementation using SAP BRIM would be more appropriate.
- **One-time charge model**
  As with the fixed recurring model, the one-time charge model is part of the standard functionality delivered by the SAP S/4HANA SD functionality but can also be included as part of a more complex subscription model in SAP BRIM.
- **Seat- or meter-based model**
  Similarly to the previous described models, the seat- or meter-based model can be delivered using the standard SAP S/4HANA SD capability or can be included as part of a more complex subscription model using SAP BRIM.
- **Usage-based model**
  The SAP S/4HANA SD option for subscription billing allows you to process consumption billing data and create invoices on the basis of billing documents. SAP S/4HANA currently doesn't provide a charging solution for consumption-based models, so an external charging solution for the generation of billing data is mandatory. Using SAP S/4HANA for subscription billing with the SD option, you can take consumption billing data originating from SAP Convergent Invoicing (part of SAP BRIM), transfer it to SD, and then post the revenue in accounts receivable (AR).

2.5 Customer Service

Customer service is a capability that SAP offers through both SAP C/4HANA and SAP S/4HANA. We looked at the capabilities of SAP C/4HANA in Chapter 1. The origins of the SAP S/4HANA solution can be traced back to the Customer Service (CS) and Plant Maintenance (PM) modules, which started life in the R/2 and R/3 ERP products and were continued into the SAP ERP release.

The challenges with delivering customer service from an SAP ERP platform were around CX. The solution wasn't easy to use, wasn't designed to be exposed through key channels such as web self-service or contact center, and didn't consider the process from a customer's viewpoint.

Out with the Old

These problems were in part responsible for SAP launching its specialist on-premise SAP Customer Relationship Management (SAP CRM) product, which was more customer-centric in its approach to delivering customer service processes. For firms that deployed SAP CRM, the most common scenario was to deploy SAP CRM to customer-facing staff, where customer demand was captured and services delivered, and then to use integration back to the SAP ERP platform where downstream processes and tasks would be performed.

These dependent processes include areas such as MRP, inventory management, billing, pricing, and time-recording, which are all vital elements of the end-to-end service processes.

With the recent migration of features from SAP CRM directly into the SAP S/4HANA product, customers are now able to blend elements of a specialist CX solution with the heavyweight SAP ERP customer service processes to deliver a complete solution to customer service.

We looked at some of the recent trends impacting customer service departments in Chapter 1, so here we'll focus on the processes and requirements that SAP S/4HANA customer service specifically addresses and the deployment options available to SAP customers considering a customer service project.

2.5.1 Customer Service Models

There are two main customer service models to describe the capabilities of SAP S/4HANA customer service. We'll deal with the simple model first, which is more predominant in B2C industries.

This model is typically used when some of the following conditions apply:

- The original purchase was for a relatively low value item.
- A large number of service requests can be resolved in the first interaction.
- There are no complex maintenance and repair processes involved.
- Customers can self-serve for basic requests.
- Customers are rarely charged for the provision of services.
- Customer service is normally delivered remotely from a contact center, not through a field-based engineer.
- No formal contract is in place, other than product warranties or guarantees.

A good example of this is a supermarket selling groceries. Some common examples of the service requests they receive include the following:

- "Where is my nearest store?"
- "What time do you open?"
- "Do you sell...?"

Of course, there will occasionally be more serious service requests, such as regarding damaged products or where the customer has fallen ill after eating something purchased at the store. Generally, however, the customer service model is based around a simple ticketing process, which we presented in Chapter 1, Section 1.5.

In this simple model, there is a need to register customers, provide channels through which they can make a request, record specific request details, resolve the request, pass this information back to the customers, and report on this data.

Digital Disrupter

Today, passenger cars are able to self-diagnose faults, book a repair visit, and order the parts required to complete the repair. Printers are able to order replacement cartridges as ink levels run low. In the future, as the IoT grows and more devices are capable of determining consumption, stock-level and predicted future demand-level firms will receive an increasing proportion of orders from devices—not humans.

This represents a huge efficiency opportunity for firms, as customer service desks that previously had to be staffed are no longer required. Firms also have an opportunity to generate incremental revenue because the car never forgets to book its service, and the printer never forgets to reorder its ink. For the customer, there is a benefit of convenience.

It sounds straightforward, but there are challenges. For a start, you need to know that if you order and ship on the customer's behalf, you'll need to sign them up and capture their billing details. You'll also need to consider data privacy, particularly in B2C where you may be collecting information about an individual's whereabouts and preferences. If a firm can overcome these problems, then there is an opportunity to create new automated ordering channels that simultaneously improve the CX and the bottom line.

With the creation of SAP S/4HANA for customer management, SAP now offer features from SAP CRM inside the SAP S/4HANA product, which can be used to provide a contact center application to wrap around the core service process itself. The purpose of this application is to bring efficiency into the service process by providing agent productivity tools that reduce average handling times and improve first-call resolution rates.

The service process itself can be run using customer master records (either preexisting or created as part of the first interaction) and service notifications to capture the customer requests and process them through to completion. Standard analytics are available for reporting.

The second customer service model is more complex and is found more frequently in B2B industries. It commonly occurs when some of the following conditions apply:

- The customer purchases high-value items and/or MTO items.
- The delivered products are technically complex and have a maintenance schedule associated with them.
- Customer service is delivered by field-based service engineers.
- The customer's business is severely impacted by a product failure.
- Service contracts are sold to complement product sales.

A good example of an industry where these conditions apply is winemaking. To make wine, a press is required to extract the juice from the grapes. Winemakers buy industrial presses from specialist manufacturers (unless the winemakers are very small, in which case, they might still tread them by foot).

In this example, the original purchase is expensive, and the product will be tailored to the specific requirements of the winemaker. The winepress itself is a complicated piece of equipment that must be maintained regularly to keep it operable. When maintenance is required or a repair needed, a field service engineer will attend to provide this. If the press fails during the harvest season, the grapes could very quickly rot and the winemaker's business would suffer.

The customer service model that exists here is altogether more complicated. The press manufacturer needs to understand the specific technical details of each press, where it's located, when it was purchased, and whether there is an active maintenance contract associated with it, alongside a multitude of other outside processes, such as claim processing, repair dispatching, engineer timekeeping, and invoicing.

These complex aspects of customer service require integration to dependent ERP processes that manage MRP, inventory, dispatch, order management, time sheets, and billing.

2.5.2 Solution Options

By now, you may be slightly confused. We've described customer service functionality in SAP S/4HANA and how it can be used to deliver a process that was previously described in the SAP C/4HANA chapter. We've explained that parts of the old SAP CRM on-premise solution now exist in SAP S/4HANA.

So let's look at the deployment options that SAP customers can choose from when considering their customer service project and the potential merits of each.

There are now the following three main deployment options for SAP customers considering a customer service project:

- **SAP S/4HANA standalone**
  Historically, one of the main challenges with this option was that the solution was very internally focused with little thought given to the customer's needs. This has now been addressed in part through the porting of SAP CRM features into SAP S/4HANA.

  With the Customer Interaction Center (CIC) features provided by SAP S/4HANA for customer management, it's now possible to run the lightweight process in SAP S/4HANA using the customer-centric features and agent productivity tools that this provides. For firms that haven't yet embarked on an SAP C/4HANA road map, this can represent a compelling option.

For the complex customer service model, SAP S/4HANA will always be required in some capacity because it provides much of the back-office integration that we've discussed previously. There is now an option to expose some of the native features of contract management and service order processing through the CIC to create a more customer-centric wrapper around the core application.

- **SAP S/4HANA and SAP C/4HANA hybrid**
  This option uses SAP C/4HANA to manage the customer-facing aspects of service processing and SAP S/4HANA for the underlying back-office service processes. This effectively requires SAP Service Cloud for field-based users and occasional office users while the SAP Customer Engagement Center is used for contact center staff. The SAP Commerce Cloud is deployed for self-service processes accessed by customers directly.

  This option makes sense where there is already a strategy or investment made in SAP C/4HANA or where there are specific features required from the SAP Service Cloud that aren't available through the SAP S/4HANA feature set. A good example of this is SAP C/4HANA's capability to support social media platforms as customer service channels, which isn't available natively in SAP S/4HANA.

- **SAP C/4HANA standalone**
  In this option, SAP C/4HANA runs the customer service solution without an SAP S/4HANA system present in the landscape. It's important to stress that without a connected ERP system present, the complex scenario we discussed earlier couldn't be delivered entirely from the SAP C/4HANA system.

  For the simple customer service model, it would be possible to deploy a solution to support that scenario from an SAP C/4HANA system. Considerations would need to be made around master data as there will be other enterprise systems containing customer and product data, so somehow that would need to be synchronized. There may also be a requirement to integrate to other enterprise system or services if there was a cross-dependency on customer service data.

  This could be an attractive option for firms that are looking to deploy a customer service quickly and either don't have an SAP S/4HANA system in place or don't want to exchange data with that system. The deployment cycle for SAP Service Cloud will generally be faster than deploying the same business processes within an SAP S/4HANA system (particularly if SAP S/4HANA isn't already operational).

These options are summarized in Table 2.2.

Feature	SAP C/4HANA Only	Hybrid	SAP S/4HANA Only
Field service/ mobile	SAP Service Cloud provides an app for all major processes and features with offline supported as standard.	SAP C/4HANA is used as the customer-facing application, and all major features are available with offline support.	Mobile Asset Management provides notification, order management, and inspection processes on mobile device via SAP Fiori.
Contact center	Specialist Service Engagement Center application is used for high-volume contact centers; SAP Service Cloud is used for lower volume requirements. Digital channels are automatically supported. Artificial intelligence (AI) is integrated into the application.	Standard integration is available between SAP C/4HANA and SAP S/4HANA for specific processes. SAP C/4HANA provides support for digital channels. AI is integrated into the application.	CIC provides a tailored contact center application suitable for use in high-volume scenarios. Limited support is provided for digital channels, such as social media.
Web self-service	Self-service is provided via integration with SAP Commerce Cloud.	Self-service is provided via integration with SAP Commerce Cloud.	Self-service integration is possible via SAP Commerce Cloud. Some custom development/ integration is likely.
Simple service model	The simple model is supported through a service ticket process.	The simple model is supported.	The simple model is supported through CIC.
Complex service model	The complex model is not supported.	The complex model is supported through integration of master and transactional data between SAP C/4HANA and SAP S/4HANA	The complex model is supported natively.

Table 2.2 Customer Service Deployment Options with SAP C/4HANA and SAP S/4HANA

Feature	SAP C/4HANA Only	Hybrid	SAP S/4HANA Only
Customer experience	Customer-centric application design is provided with support for major customer engagement channels out of the box.	Customer-centric application design is provided with support for major customer engagement channels out of the box.	Limited customer-centric design is provided. Some support is missing for new digital channels.
Agent productivity	Use of AI and bots is possible to automate repetitive tasks and remove human involvement from low-value tasks.	Use of AI and bots is possible to automate repetitive tasks and remove human involvement from low-value tasks.	CIC provides basic productivity tools, such as auto-complete and automatic preparation of outbound email.

Table 2.2 Customer Service Deployment Options with SAP C/4HANA and SAP S/4HANA (Cont.)

2.6 The Road Ahead

CX in SAP S/4HANA remains a critical aspect of SAP's overall ERP offering. The majority of the SAP ERP installed base runs the SD module for their order-to-cash process, and as these businesses begin to migrate to SAP S/4HANA, they will continue to need this core capability.

Historically, the SD module has been heavily customized and modified by SAP customers; however, this approach is at odds with SAP's publicly stated cloud strategy (SaaS assumes less variation and customization by individual customers). This gap will have to be addressed either by SAP offering more software features to deal with low-volume use cases or by SAP partners building certified add-ons to deal with this problem.

The feature overlap between SAP C/4HANA and SAP S/4HANA will continue to create some confusion, which is likely to be compounded by the acquisitions SAP is making in CX. There is likely to be some rationalization in this respect because in areas such as incentive and commission management, it makes little sense for SAP to develop and support three different applications to deal with the same business scenarios and processes.

For many years, SAP has found dedicated CX software vendors encroaching on their SAP ERP installed base, with customers using the likes of Salesforce over SAP CRM.

With the launch of SAP C/4HANA, SAP will be going after these competitors with a view to dislodging and replacing them with SAP C/4HANA. This will put an emphasis on integration and new end-to-end business processes run over SAP S/4HANA and SAP C/4HANA, which will put SAP at an advantage over its CX competition.

SAP has also announced the integration of SAP CRM into the SAP S/4HANA product, which will provide SAP S/4HANA customers with access to a limited range of the SAP CRM capabilities drawn from the sales and service components. The uptake of this option by new SAP S/4HANA customers will be an interesting area to watch.

Despite some of these obvious challenges, this CX space remains an important part of SAP's S/4HANA offering, for SAP and its customers.

For firms to deliver great CX, they need to be able to leverage and access their back-office processes and data to be transparent to their customers and to solve problems effectively on their behalf. The CX component of SAP S/4HANA provides this window into the inner workings and processes of the firm.

New business models and digital technology will continue to disrupt the order-to-cash process as we've seen with PaaS. SAP's customers will rely on these models to help solve these problems and exploit the opportunities that exist, placing greater emphasis on the quarterly software development and release cycle. Challenging but interesting times are ahead for SAP and its CX installed base.

In the next chapter, we'll turn away from the world of customer service and venture into the realm of operations, starting with supply chain planning.

PART II

Operations

Chapter 3

Supply Chain Planning with SAP Integrated Business Planning

This chapter introduces supply chain planning, which is a topic that can be somewhat opaque to those for whom supply chain planning isn't a principle focus. We'll endeavor, however, to explain the key concepts before taking a more detailed look at SAP's new supply chain planning product—SAP Integrated Business Planning (SAP IBP).

Conceptually, if not in execution, supply chain planning is simple: it's the discipline of ensuring that the supply chain has the optimal supply capability to meet the excepted demand of the business. There's a fine line regarding the risk of running out of stock in which not fulfilling customer orders is balanced against the costs and risks of holding too much stock. It's both an art and a science that requires the creation of an accurate demand plan and the satisfaction of this plan through various supply "levers" through which planners can adjust stock levels of either finished goods, semifinished goods, or raw/component materials at various locations throughout the supply chain.

For those who are familiar with SAP in the area of supply chain planning, two products are likely to sprint to mind: SAP Advanced Planning and Optimization (SAP APO) and SAP Integrated Business Planning (SAP IBP).

SAP APO is the most widely used advanced planning solution in the industry, with more than 2,000 customers across all regions. SAP APO provides a complete set of advanced supply chain planning applications on a central integrated platform.

More recently, however, SAP launched SAP IBP, which is effectively the umbrella term for five individual cloud-based software-as-a-service (SaaS) modules that share a common platform, data model, and Excel-based user interface (UI).

Let's begin with a brief outline of each of the five constituent modules:

- **SAP IBP for sales and operations**
  Supports the entire S&OP process, which will be discussed at length in this chapter. Simply put, this module contains the functionality required to support any organization's monthly S&OP process, which involves the creation and agreement of a demand and supply plan together with capabilities to help facilitate the various formal meetings that form part of the S&OP process.
- **SAP IBP for demand**
  Combines traditional statistical forecasting techniques with demand sensing and emerging machine learning functionality with the aim of establishing the most accurate view of demand possible.
- **SAP IBP for inventory**
  Provides the functionality to enable an organize to optimize its inventory levels wherever inventory is held throughout the supply chain.
- **SAP IBP for response and supply**
  Manages the part of the process where forecast meets reality. The purpose of this application is to provide short-term updates to the forecast as well as trigger and refine replenishment orders and, when necessary, prioritize sales orders in line with company priorities.
- **SAP Supply Chain Control Tower**
  Provides end-to-end visibility throughout the supply chain by integrating data from various systems with configurable analysis and alerts. SAP Supply Chain Control Tower enables visibility into all stages of the supply chain through key performance indicators (KPIs) and dashboards.

From an SAP product perspective and indeed when looking at this book, there is a differentiation between *planning* the supply chain and *executing* the supply chain (which is detailed in Chapter 6). In this chapter, we'll focus on the process of agreeing on a consensus view of likely demand and the subsequent development of a supply plan that looks to both fulfill the demand while also remaining cognizant of ever-increasing financial pressures. After taking a look at the state of supply chain planning for our business case, we'll look at the key formal process within supply chain planning: S&OP. Then, we'll explore the other areas of supply chain planning covered by SAP IBP for demand, SAP IBP for inventory, and SAP IBP for response and supply.

3.1 Business Case

In line with many organizations, Bault Robotical has a complex supply chain with multiple manufacturing facilities, distribution depots, and customers around the globe. To make things even more complex, Bault Robotical also has different product lines that are manufactured based on a variety of triggers. For example, the large complex robots at the premium end of Bault Robotical's price list are manufactured for individual clients based on specific requirements, whereas at the lower end of the price list, robotic vacuum cleaners are manufactured solely based on forecast requirements.

Set against this complex backdrop, the requirement for Bault Robotical to understand its supply chain is paramount because despite its complexities, the pressure remains to meet customer service levels while also reducing inventory levels and unnecessary handling costs. At the core of this conundrum sits the question of how best to purchase, manufacture, and hold inventory (location, amount, state) to meet a demand that doesn't yet exist.

In an attempt to answer this question, Bault Robotical invested in SAP IBP, a cloud-based SaaS solution. However, Bault Robotical was also aware that adopting a new system would not in and of itself transform its supply chain from one where forecasts were inflated by the sales and marketing departments and ignored by the supply chain and where the total value of inventory was too high due to the perceived need to maintain blanket contingency. In an attempt to knock down the siloed approach to supply chain planning, Bault Robotical introduced a formal monthly S&OP process facilitated through SAP IBP for sales and operations and intended to drive a consensus view of demand and a connected understanding of supply. Together with producing an agreed company-wide view, this monthly process also gave the Bault Robotical executives the ability to approve or amend the plan to ensure that the decisions being made were aligned with the overall business strategy.

Bault Robotical also spent a good deal of time looking into demand sensing for its mass-manufactured items (e.g., robotic vacuum cleaners) and found that combining this discipline with traditional forecasting provided a much more accurate plan from which manufacturing could execute. (Demand sensing is expanded on later in this chapter.)

3.2 Sales and Operations Planning

As outlined in the preceding case study, the benefits of a robust and mature S&OP process are widely accepted, as are many of the deficiencies inherent in many S&OP processes in organizations today.

In practice, S&OP is a formal, generally monthly process designed to assess and decide the demand plan (what will be sold) together with the subsequent supply plan (what needs to be bought and manufactured).

The S&OP process is intended to promote collaboration and ensure that rather than working in silos, all areas of a business are working on one agreed plan with one source of data. In practice, this collaboration should bring together senior management from sales, marketing, procurement, manufacturing, finance, and logistics departments. They should have the shared goal of creating the best overall balance of inventory, production capabilities, customer service levels, and supply availability to maximize profit and satisfy the company's strategic goals.

3.2.1 Challenges in Sales and Operations Planning

We'll now discuss some of the business problems that S&OP is intended to solve. These issues are generic in nature, and the level to which each of these factors affect a specific business will vary significantly by industry sector. That being said, let's begin with an issue that is shared across most (inventory-based) industries:

- **Failing to fulfill customer orders**
  A common theme across all commercial organizations is a desire to increase revenue, decrease costs, and maximize profits. A "sale" is the trigger to realize revenue, but if the customer order isn't fulfilled, then the sale can't happen. This both immediately impacts the organization's bottom line and opens up the possibility of commercial penalties and potential reputational damage. Therefore, a fundamental requirement of the S&OP process is the need to avoid running out of stock (stock outs) that will affect the business's ability to ship products to a customer and make a sale.
- **Excess inventory**
  In common with stock outs, making, purchasing, or holding too much stock (excess inventory) can significantly impact the profitability of any business.

  At a basic level, a business incurs costs when it manufactures or procures a product. The very nature of business means that the organization believes that this

cost will be less than the revenue it will receive when the finished product is sold; the greater the difference between the costs and the revenue, the higher the profit. A less obvious type of business expense, the carrying cost, is basically a cost associated with the handling and holding of inventory. We've categorized these type of costs into the following four types:

- Committed capital: Every item of inventory represents tied up capital, meaning that this money can't be used elsewhere in the business. Too much capital committed into inventory may well hamper the ability of the organization to exploit new opportunities that require access to liquid capital.
- Handling costs: Whenever materials are "touched," costs are incurred. Even in an optimal supply scenario, costs can be significant, and this is only exacerbated by excess inventory. For example, handling excess inventory can involve either bringing in additional machinery, reducing the life of existing machinery, or requiring additional labor.
- Facilities and storage costs: In addition to machinery and labor costs, the greater the levels of inventory, the greater the requirement for warehouse space. Many organizations today lease warehouse space, but even when an organization owns the warehouse, related costs, such as electricity and insurance, also increase with stock levels.
- Obsolescence and scrapping: In many organizations, new products are introduced as old ones are retired. Therefore, holding too much stock that can become obsolete is a risk. Even when inventory remains relevant holding stock for an excess period of time increases the chances of shrinkage (theft or damage). In this scenario, the stock may either be written down (the value of the inventory is reduced) or written off (the stock no longer has any value). Once again, this means costs are incurred, with no revenue to offset it.

- **Production costs**

  One of the key expenses for any manufacturing organization is the cost of its workforce. If shift patterns or the number of people on shift aren't proportionate to the amount of stock to be manufactured, then either the ratio of cost to revenue is distorted or the organization fails to produce the requisite amount of stock to fulfill customer orders.

  In common with labor, running a machine incurs costs that may not be immediately obvious. Many machines are maintained using simple planned maintenance cycles whereby they are automatically stopped and maintained after a certain

amount of use. If the machines are engaged in activities that accelerate the incurring of maintenance costs yet have no association with revenue, then this is an unnecessary expense.

These challenges represent a subsection of the traditional issues that the S&OP process is intended to overcome; however, with the advent of the digital economy, the S&OP process also needs to deal with the following new considerations:

- **Fulfillment**
  Today, customers expect a fundamentally better experience when it comes to the fulfillment of orders. Unlike even a decade ago, customers expect to have the option for next-day delivery by default with companies such as Amazon offering same-day or even same-hour delivery. Together with speed, customers also expect to have the ability to track orders, pick delivery slots, and be notified of actual delivery times.

Digital Disrupter

Amazon has shaped the fulfilled expectations of millions of consumers around the world. Much of the success of its business model is centered around the efficiency of its supply chain and its ability to satisfy customer orders in ever-decreasing timescales. Amazon hasn't rested on its laurels and is now investing heavily in drone technology under the banner of Amazon Prime Air. Amazon describes Prime Air as "a future delivery system that will deliver packages to customers in 30 minutes or less using small unmanned aerial vehicles."

- **Personalization**
  Together with a "new normal" concerned with the fulfillment of orders, customers also expect the ability to personalize products with little or no impact on delivery. This expectation ranges from the ability to personalize items prior to manufacture, such as clothing, as well as in terms of "hyperpersonalized" service, such as offered by HelloFresh in creating individual "taste profiles" for each customer based on what they like and don't like.
- **Returns**
  The return rate for products ordered via the Internet is in the region of 30%, which compares to just 8.89% for brick-and-mortar stores. Therefore, organizations need to have a far more streamlined and robust process to deal with this reality. From a business perspective, returns have a significant impact on stock availability, revenue calculations, and forecast projections.

- **Product safety and compliance**
  Vaccines are biological substances that either lose their effectiveness or quickly become dangerous if they get too hot or cold. Therefore, for this type of product (and other similar products), it's important that throughout the supply chain, the temperature is maintained and proven. In a worst-case scenario, whole shipments of valuable pharmaceuticals may need to be destroyed if deviations occur, resulting in lost revenue, reputational damage, and patient safety concerns.

Digital Disrupter

When considering the handling of temperature-sensitive substances using blockchain and the Internet of Things (IoT) technology, triggers can be set to automate control and even regulation of temperature. For example, with this technology, triggers can be placed into a process that can be used to monitor and alert when the temperature of the drugs is getting close to exceeding tolerance. If set within a delivery van or truck, this can be used to alert the driver to rectify the situation or alternatively immediately turn on the air-conditioning. Together with these benefits, the blockchain functionality reduces potential fraud or errors in the traceability of these temperature-critical items. When applied to the cold chain, blockchain technology can create secure documentation of storage temperatures at every step of the product's journey regardless of where the product is in the supply chain. Cleary, industry is beginning to sit up and take notice of this technology with the pharma industry alone estimated to spend nearly $17 billion by 2020 on cold chain management.

The S&OP process is intended to act as the link between strategic long-term planning and the tactical and operational planning that is performed immediately before execution (we'll discuss these stages at more length later in this chapter). The intention is to ensure that execution is in line with the strategic goals of the organization when possible. Let's dive into each type of planning and the corresponding SAP IBP for sales and operations functionality in the following sections.

3.2.2 Demand Planning

The first step is demand planning. The purpose of demand planning is to achieve the most informed and accurate forecast possible. The importance of this process can't be overstated as the demand is the starting point for everything else in this process. If the demand is overstated, then it's likely that an organization will end up either

manufacturing or procuring unnecessary stock, or, conversely, if the demand is understated, then likely some "real" customer demand will be left unfulfilled.

The outcome of the demand review is the finalization of the sales plan that will be used as the basis of the supply review in the next step. This process uses the collective knowledge and ability of sales, marketing, and demand management teams and generally follows the following process:

1. **Product review**
   The product review process is concerned with analyzing products either at the beginning of its life cycle (new part introduction, NPI) or at the end of life (EOL). If we consider the latter scenario first, providing information to the supply team regarding expected sales of the product reaching EOL should ensure that the supply team has the best information possible with which to ensure that any further production is controlled and that the "run out" of existing stock can be managed. Conversely when new products are introduced, the supply team needs to understand the likely size of the market, number and location of customers, and an estimation of units expected to be sold. Together with a view of how much of a product to produce, the product review process also allows for the analysis of the product development so that the "real" lead time to launch a product is taken into account when considering when to schedule the demand.
2. **Demand forecast**
   During this step, SAP IBP for sales and operations should be used to generate an unconstrained base forecast. This essentially means an estimation based on historical data of the total quantity that would be sold if there were no constraints in the supply. Typical constraints that aren't considered here include items such as production or delivery capacity. SAP IBP for sales and operations contains various statistical models and allows for further models to be created. Although this is a topic that gets very technical, very quickly, basically the model will take the historical sales information and use it to predict the future demand. Generally, before this job is run, the historical demand will be checked and any anomalies or outlier information removed.
3. **Forecast adjustment**
   With the base forecast established in the previous step, the next stage is to fine-tune this forecast based on market information and the specific knowledge of different groups within the business. Different planning views can be created within SAP IBP to allow different personas to enter information.

For example, a sales rep may enter the following specific information: the total forecast by product (or product family), split by customer, time period, price, and associated revenue.

This can be held offline as a standalone spreadsheet; however, once saved, the information is instantly shared and visible to everyone else involved in the S&OP process. Other personas include sales managers and marketing, with the latter allowing the tracking of events and promotions and providing common information throughout the S&OP process.

4. **Consensus demand planning**
   The final step in the demand review process is to finalize the consensus demand that will form the basis for supply planning. This is generally coordinated and led by a demand planner and facilitated through views (such as the one shown in Figure 3.1) in which the various forecasts entered can be displayed.

Product Family	Customer	Key Figures	18-Jan	18-Feb	18-Mar	18-Apr
12345	Customer ABC	Sales Fcst Qty	5400	30102	5500	...
		Sales Mgr Fcst Qty	7600	40000	7300	...
		Marketing Fcst Qty	6200	34555	6200	...
		Promotion Fcst Qty	1200	7100	1400	...
		Statistical Fcst Qty	7200	23000	5000	...
		Consensus Demand Plan Qty	6590	35433	6272	...

Figure 3.1 Consensus Demand Plan

After the consensus demand is agreed on, this then forms the basis for the supply review, which we'll discuss next.

3.2.3 Supply Review

After the demand review is finalized and a consensus view of the demand is agreed on, this information is then used by the supply team who must subsequently determine how this can best be satisfied while remaining within the confines of optimum stock levels, efficient production sizes, and minimum handling costs. Various scenarios may be investigated as the supply team looks to flex production capabilities, optimize inventory levels, calculate the best "state" to hold the inventory in (raw, work in progress [WIP], and finished), and work out where inventory should be held in the network. Completion of the supply review should result in a working supply plan.

The purpose of the supply review is to understand how the unconstrained consensus demand plan can best be met through available supply options, such as production,

purchasing, inventory usage, and stock transfers. At the same time, the supply review must also consider customer service levels, inventory levels, and operating costs.

Inputs to the supply review include the following:

- Unconstrained forecast
- Up-to-date inventory levels
- Production capacity
- Purchasing lead times and any other procurement constraints
- Warehouse storage capacity and material handling capacity
- Transportation capability of an organization, along with the capability and flexibility of the logistics partner
- Hard customer commitments or service-level agreements (SLAs)

The output of the supply review is the generation of a rough-cut plan. SAP IBP contains the bill of material (BOM) and production information for materials produced in-house along with lead times and any purchasing constraints for procured materials.

By having access to various master and transactional data elements, such as stock position and safety stock requirements, when a supply planning run is executed, the result leads to issues of overload on production lines, unavailability of warehouse space, or various other factors that mean the as-is forecast can't be achieved without additional action or negotiation. Figure 3.2 outlines this scenario.

Product Fa	Customer	Location	Resource	Key Figures	Jan-18	Feb-18	Mar-18
12345	Customer ABC			Consensus Demand Plan Qty	6590	35433	6272
				Production Receipt Qty	7020	36456	5050
		Plant 1010	Machine 01	Utilisation	90%	120%	150%
		Plant 1020	Machine 02	Utilisation	25%	40%	60%

Figure 3.2 Capacity View

It's these situations that require what-if scenario analyses to model what would happen if various courses of action were taken. For example, in the case of overuse of a production line, what would happen if an extra production shift were added, the material was shifted to an additional production line, or the material was procured externally? Hand in hand with understanding how to meet the consensus demand, the supply planning function must also seek to maximize profit through the minimization of additional costs. In the same vein, if as part of the supply review, underuse is identified, then a promotion can be considered to increase demand and therefore

maximize the usage of the available resources. SAP IBP provides for multiple scenarios to be mapped and compared to help resolve gaps. Once resolved, this then forms the input for the next step of the process: the pre-S&OP review.

3.2.4 Pre-Sales and Operations Planning Review

Often the previous two steps will have taken place independently, so the purpose of the third step (the pre-S&OP meeting) is to bring these disparate departments together with the aim of filling in gaps and addressing any mismatches between the sales plan and the demand plan. During this stage, various scenarios may be modeled to understand how best to balance the competing interests of demand and supply. For example, sales may ask what the impact would be on supply if the organization secured five more customers, whereas supply may ask what would happen if we were to close a warehouse or reduce the shifts in a particular manufacturing facility. The purpose of these what-if models is to come to an agreement over any areas of conflict. If a consensus can't be reached, the matter is taken to the executive review.

SAP IBP for sales and operations facilitates the pre-S&OP review by providing one consistent set of numbers and scenarios for debate. At this point, it's also worth highlighting the collaboration features of the application, which include a discussion group functionality within SAP Jam and live discussions together with information sharing, document upload, and decision-making tools. SAP Jam provides the connection to all actors in the review to allow for collaboration and knowledge sharing even when the teams are geographically dispersed.

3.2.5 Executive Review

As the name suggests, the executive meeting is a chance for the executives to understand and approve the demand and supply plans. It's generally a relatively short meeting and provides an opportunity for the executives to ensure that the plan is aligned to the strategic goals and direction of the organization.

Out with the Old

Many traditional S&OP processes focused primarily on demand and supply plans based on volume (quantity); however, modern businesses need to take a more holistic view and consider additional factors such as time, money, equipment, and so on. SAP IBP was introduced as an advanced or next generation of S&OP, which broadens

its ambition and reaches from within the confines of the supply chain to encompass product development, finance, and a strong focus on strategic alignment. It has been suggested that by broadening the scope of S&OP beyond the supply chain, SAP IBP enables a wider community within the organization to become involved in the day-to-day planning of the business. It also ensures one set of numbers (volumes and financials) that the entire business can use as the basis for decision-making.

SAP IBP enables the creation of dashboards that provide for summarized, easy-to-consume information for presentation at the executive review. A typical dashboard will contain various KPIs agreed on with the executives that capture the plan to be approved and any conflicts that need to be resolved.

Having described how the SAP IBP solution for S&OP supports an organization's sales and operations process, we'll now explain how the other four applications complement this core component. It should be stated from the outset that there is a significant degree of crossover, and often the key difference between the S&OP application and the other is the scope of the solution, with the additional applications offering more options, models, and functionality.

3.3 Demand Management

As outlined in Figure 3.3, SAP IBP for demand is an end-to-end planning engine that combines traditional statistical planning methods for mid- to long-term planning with a demand-sensing functionality required for more reactive planning. SAP IBP for demand also provides additional functionality to that offered by SAP IBP for sales and operations, and the business requirement that this functionality is designed to provide is the same as the first stage of the S&OP process, that is, the creation of an accurate and agreed-on consensus demand plan.

Statistical forecasting as a concept has been introduced in Section 3.2, but to reiterate at a basic level, it's the discipline of using historical data to predict future behavior. SAP IBP for sales and operations also uses statistical models; however, SAP IBP for demand contains both these models and a myriad of additional models that allows planners a greater choice.

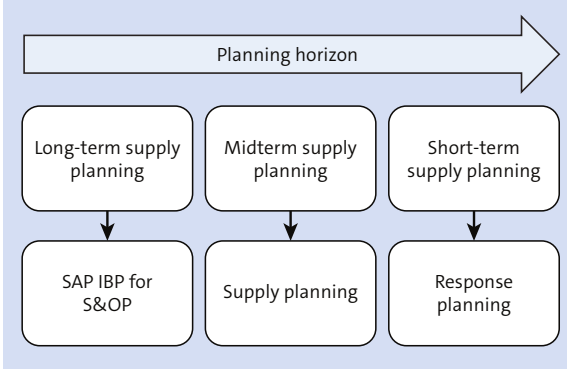

Figure 3.3 SAP IBP for Demand

However, together with this greater degree of statistical forecasting, SAP IBP for demand also crucially contains demand-sensing functionality. Demand sensing is a method of forecasting that augments traditional demand planning by leveraging downstream sources such as point of sale (POS) information and weather signals. The forecast created through demand sensing can therefore be updated to reflect emerging trends and new information as soon as this information becomes available, thus removing the latency between the plan and what is actually happening in the supply chain. This has led to claims that demand sensing can reduce the forecast error of short-term forecasts by up to 50%.

Demand sensing works by identifying (sensing) demand signal changes and comparing these to the statistical demand to evaluate whether the difference is statistically significant. It can do this mid-period using pattern recognition and predictive analytics to detect trends in replenishment orders and to identify and respond to gaps caused by changes in expected customer demand.

3.4 Inventory Management

In Section 3.2.3, we outlined the supply review in SAP IBP for sales and operations, which described the need for a supply plan that accommodates the demand plan. In reality, however, this is an oversimplification of the challenges and pressures that exist for the supply side of the business when deciding what a suitable supply plan looks like. At its core, SAP IBP for inventory can be used to try find the optimal state for inventory that will balance the need to supply to fulfill customer demand while

keeping the lowest possible levels of stock. If stock levels are too high, then working capital that could be invested elsewhere is tied up; the risk of damage, obsolescence, or theft increases; and profit levels are reduced. Conversely, if inventory is too low, then the organization risks defaulting on customer orders, leading to potential reputational damage and a loss of revenue. Many organizations will hold inventory in different places and in different stages of manufacture in an attempt to react more quickly to deviations in demand.

Once again, for the sake of clarity, we should highlight that SAP IBP for inventory addresses the same business challenges as outlined in the SAP IBP for sales and operations (supply review), and in concert with Section 3.3, this application provides additional functionality beyond that offered by the S&OP application.

In the following sections, we'll discuss three key facets of inventory management: inventory quantity, inventory state, and inventory location.

3.4.1 Inventory Quantity

The key questions for SAP IBP for demand is how much inventory should be held and where. At a conceptual level, this sounds like a simple question to answer, but when we consider the complexity of a modern enterprise, including the sheer number of products and component materials, customers, warehouses, production plants, distribution centers, and cross docks that can be geographically dispersed across the globe, then the complexity begins to emerge.

From a process perspective, inventory optimization sets much of the data needed to create the supply within the S&OP process. Therefore, it can be considered as "fitting in" after the consensus forecast has been created but prior to the creation of the rough-cut production plan.

Before we deal with this complexity, however, let's consider the simplest of scenarios: we have 20 items in stock (on hand) and a replenishment time of 10 days. At the end of 10 days, all the inventory will have been used up just as the next order for 20 items arrives.

Of course, life isn't always that straightforward, and even mature organizations tend to find that forecasts are never more that 70%–80% accurate, meaning that, in our example, we'll either have two to three extra items in stock or a deficit of two to three items that a customer requires but which we're unable to supply.

Due to these variables, SAP IBP can perform the following types of calculations based on key inputs:

- **Safety stock**
  Many organizations will hold a form of contingency, and the most common (and basic) of these is safety stock. Safety stock is simply a quantity of stock that is held just in case, as contingency for forecast inaccuracy or any other scenario that will either increase demand or effect replenishment. Safety stock is created for each period (week, month) and can change over time.
- **Cycle stock**
  Cycle stock represents the amount of stock that an organization plans to sell to satisfy planned or forecasted orders within a specific time frame.
- **On-hand inventory**
  The amount of stock that is physically present within a depot or warehouse.
- **Target inventory**
  Target inventory is the quantity of inventory that was planned as the optimal amount of inventory at a certain location. This figure is relevant to replenishment calculations.
- **Pipeline stock or pipeline inventory**
  Pipeline stock refers to materials that have left the warehouse but are still in the organization's supply chain; that is, the ownership (legal title, etc.) hasn't yet passed to a customer. This scenario often occurs when the final customer is in a different geography than the supplier. For example, let's consider a manufacturer in the United Kingdom that supplies to a customer in Brazil. Now depending on various factors, the actual sale may happen as soon as it leaves the warehouse in the United Kingdom, or, conversely, it may happen when the product arrives onsite in Brazil. In the latter scenario, we have an example of pipeline inventory, which may in practice mean that the stock is either in transit (i.e., on a ship or plane) or awaiting customs clearance. In this kind of scenario, the stock may stay as pipeline stock for weeks or even months.

At its core, SAP IBP for inventory is concerned with calculating the recommended level of safety stock, level of cycle stock, and target inventory position. This is based on many inputs, over and above the forecast. Other key inputs include customer service levels and replenishment lead times. SAP IBP for inventory can either do this via single-level optimization or multilevel optimization.

In a single-level optimization scenario, SAP IBP recognizes two actors: the stocking location and the customer. All calculations are relevant to the stock location, and the safety stock calculation assumes that all replenishment times have a faultless service level.

However, in many organizations, the supply network isn't as simple as this and may include various nodes on the network. In this scenario, the engine within inventory optimization considers all the locations in the "chain". Rather than work out a safety stock level for one plant and then the other, the engine optimizes the inventory in the network to minimize the chance of disruption.

3.4.2 Inventory State

Holding material at different stages of development is a weapon that organizations use to deal with unpredictability. Simply stated (and for our purposes excluding maintenance, repair, and overhaul [MRO] materials), inventory can be classified in one of the following three states:

- **Raw materials**
  Basic materials that an organization procures from its vendors. To convert them to either finished or WIP materials, certain manufacturing processes need to be applied. It should be noted that the classification of material is very much subjective, with one company's finished material being another company's raw material. Let's consider crude oil, for example: For a company that drills for oil, crude oil represents the finished product. In turn, this is bought by oil refinement companies as a raw material to produce their finished products, such as kerosene and gasoline.
- **Work in progress materials**
  WIP material is often also referred to as semifinished goods. These are materials that have evolved from raw materials and are converted into finished goods.

  WIP can be seen as neither one thing or another because it's no longer virgin material as acquired from the vendor, nor is it intended to be sold to a customer. In lean manufacturing, WIP is considered waste. From this perspective, it's desirable to minimize the amount of inventory that is in this form so that the locked-in value can be realized as soon as possible.
- **Finished goods inventory**
  Finished goods or products, as the name suggests, represent the final transformation of the product from raw materials, through the manufacturing process, and into goods that can be sold to customers. Their value to an organization is obvious as their sale contributes to the revenue achieved by the company.

3.4.3 Inventory Location

We've now discussed the flexing of inventory amount and the state of the inventory, so we'll finish by considering the location of the inventory. Generally, organizations often physically stock the same material in different locations within the supply chain. For example, inventory may be held within a warehouse associated with a production facility and also a distribution center. While this undoubtedly provides a greater degree of flexibility when it comes to fulfilling customer orders, it also creates an issue when considering how much contingent (safety) stock should be held because, unlike the examples outlined earlier, now we have to consider two locations of supply and the need to optimize both.

From an SAP perspective, the ability to model this multilevel scenario is a feature that distinguishes SAP IBP for inventory from SAP IBP for sales and operations. In SAP IBP for sales and operations, the solution only recognizes two actors, the stocking location and the customer with all calculations pertaining to safety stock only considering the stocking location. However, as already stated, the supply network in many organizations isn't as simple, and the inventory at all stocking locations within the supply chain needs to be taken into account to define the optimal safety stock at each location. Unlike SAP IBP for sales and operations, SAP IBP for inventory contains this enhanced functionality.

3.5 Response and Supply Management

As the name suggests, SAP IBP for response and supply deals with the two specific scenarios of supply planning and response planning:

- **Supply management**
  Supply management is the name given to the process of ensuring fulfillment of anticipated or actual demand, such as sales orders or internal consumption. An organization has various ways of fulfilling this demand such as procurement of, production of, and transportation of goods and services across the supply chain. From a planning horizon perspective (and as outlined in Figure 3.4), supply management is particularly relevant for medium-term planning. Long-term planning is aligned with S&OP, and, as we'll now discuss, response planning is aligned with short-term planning.

- **Response planning**
  Focuses on a short-term horizon and specifically where the actual demand differs from the expected demand, as shown in Figure 3.4. When a deviation does occur, the organization must respond to this demand in a way that minimizes the impact of the difference to both the organization and the customer in a way that is in line with the overarching goals and aspirations of the organization. Having a robust supply plan is important.

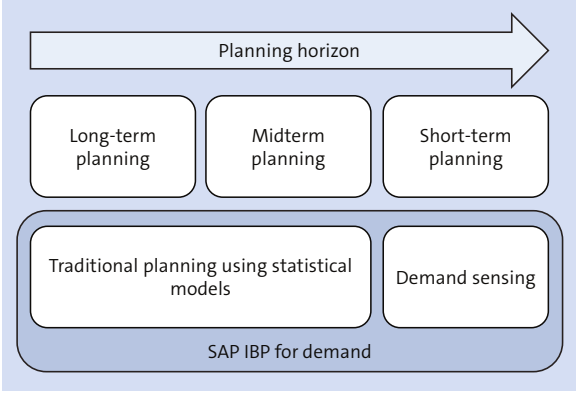

Figure 3.4 Response Planning Process

No matter how good the generated forecast is, it's ultimately an educated guess, and irrespective of how good a guess, there will be discrepancies between what was predicted and what is actually happening on the ground. We already have techniques, such as demand sensing, that should in the future go some way to mitigate this. For some time to come, however, there will remain a need to manage short-term forecasts and respond to emerging supply gaps.

From a product perspective, SAP IBP for response and supply works within the following three areas:

- **Strategic supply planning**
  The focus here is still on avoiding problems before they happen rather than dealing with them once they have. The strategic supply planning functionality within SAP IBP provides the ability to run what-if simulations and provides collaboration through SAP Jam. The type of activities performed here include the following:
  - Strategic planning: Reviewing alternative options for sourcing, together with evaluating bottlenecks and resource constraints with the aim of developing a feasible and achievable plan.

  - Optimization: Running models to understand least-cost scenarios and minimize late order fulfillment.

- **Operational supply planning**
  This is the area where strategy meets execution, and issues begin to develop. This process is intended to highlight potential pain points and enable troubleshooting.

  At this point, affecting a forecast may not be enough and actual reprioritization of demand orders may be required. In effect, this means that when competing requirements for the same product, production resource, or component material occur, it's possible through SAP IBP to prioritize the need of one customer over another. In reality, some customers are more important to a business than others. For example, in certain circumstances, an organization may choose to prioritize the order of a strategically important customer or look to fulfill orders that carry penalties for late delivery.

- **Response planning**
  Response planning is all about satisfying actual orders in the best possible way; in practice, this will once again involve the prioritization of sales orders while also amending replenishment orders to expedite or reroute incoming stock.

3.6 Supply Chain Analytics

Analytics is the final area of supply chain planning to discuss. In SAP IBP, this is supported by the SAP Supply Chain Control Tower, which is the overarching analytics solution for the SAP IBP planning applications (see Figure 3.5). The SAP Supply Chain Control Tower has been designed to provide real-time visibility, analysis, and control without the need for data transformations or external analytic software. The SAP Supply Chain Control Tower is designed to be a complete suite for management of an organization's supply chain and can connect to an organization's operational systems, such as SAP S/4HANA, to integrate actual supply chain execution information.

Furthermore an organization's supply chain isn't restricted to the organization itself and includes suppliers, logistics service providers, contract manufacturers, and other partners. The SAP Supply Chain Control Tower, therefore, is designed to enable collaboration between these actors through connectivity with the Ariba Network. Such scenarios include inventory visibility and collaborative forecasting, and they are all designed to provide all parties with the best and latest view of capacity constraints, material shortages, and other potential bottlenecks.

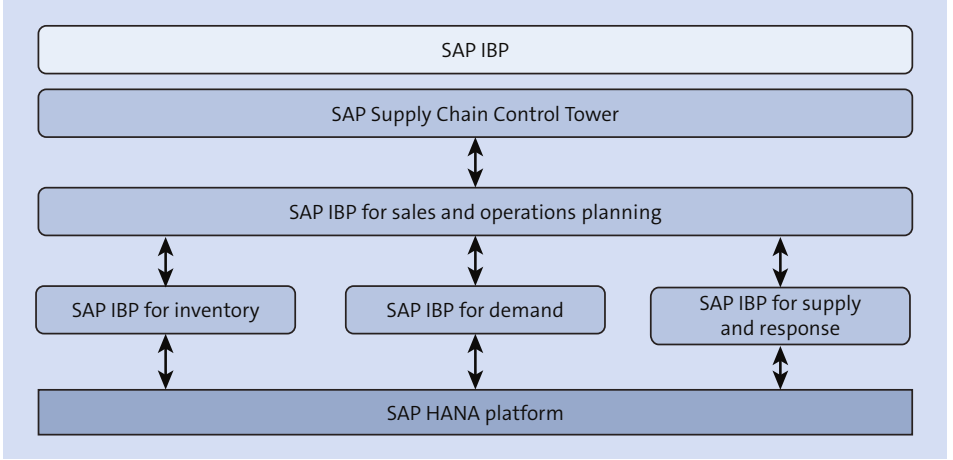
SAP IBP
SAP Supply Chain Control Tower
SAP IBP for sales and operations planning
SAP IBP for inventory
SAP IBP for demand
SAP IBP for supply and response
SAP HANA platform

Figure 3.5 Reporting Structure of SAP IBP

Together with enabling the identification and resolution of specific issues, the SAP Supply Chain Control Tower can leverage this information to help avoid similar issues from occurring in the future through the calculation and visualization of KPIs. For example, the SAP Supply Chain Control Tower can take historical information (e.g., on-time delivery over the past two months), calculate this as a percentage, and then display this on a dashboard with color coding in green to show a positive trend or red to show a negative trend.

Together with customer KPIs, the SAP Supply Chain Control Tower dashboard can also be uses to provide alerts that indicate a potential supply chain issue or disruption. Within SAP Supply Chain Control Tower, end users can define the requisite rules and logic on which the alert can be triggered and also determine how this alert is visualized within the dashboard.

3.7 The Road Ahead

Supply chain planning as a topic is somewhat specialized and takes some time to understand, let alone master. That many of the advances in this area pertain to new mathematical models, machine learning capabilities, and demand-sensing patterns does little to dispel this confusion.

Even with all its complexities, however, organizations that can master supply chain planning and deploy a robust, all-inclusive company-wide S&OP or SAP IBP solution

can reap potentially huge rewards. In addition, with the advent of new customer expectations and new technologies, supply chain complexity will only increase, and organizations that can't keep up with the pace of change will likely suffer as a result.

What SAP IBP looks like today is unlikely to be what it looks like tomorrow with recent innovations beginning to consider an ever-tighter integration to the Ariba supplier network. The Ariba Network (which is detailed in Chapter 4) provides an ever-growing capacity for organizations to collaborate and share mutually beneficial data in real time. From an SAP IBP perspective, this move is a natural one and can provide supply chain visibility beyond the four walls of the organization into the wider supplier ecosphere. Although it's a paradigm shift from a traditional arm's length supplier/vendor relationship, a move to this collaborative model can provide an insight into suppliers' landscapes while simultaneously providing reciprocal information for suppliers that can be used to enable the provision of better service levels. By integrating the entire supply chain beyond its traditional boundaries, planning supply issues and bottlenecks can be identified before they become issues, allowing resolutions to be found and mitigating actions to be taken before they become an issue for either party.

One important area of change involves demand sensing in SAP IBP for demand. At the moment, SAP IBP for demand currently only supports a single downstream signal, something that may be remedied in the 1811 version of the application. The future of SAP IBP for demand seems tightly wedded to the evolution of demand sensing and specifically to the ever-increasing application of machine learning. Currently, demand sensing makes use of machine learning in terms of pattern recognition and will soon also add the following capabilities:

- Additional machine learning forecasting algorithms
- Machine learning supporting the NPI process
- Automatic exception handling and intelligent decision support
- Flexible determination of master data (e.g., lead times)

In the next chapter, we'll take the next step in the operations world: sourcing and procurement.

Chapter 4

Sourcing and Procurement with SAP S/4HANA and SAP Ariba

In this chapter, we'll focus on sourcing and procurement as a business process before discussing the evolution from arm's-length adversarial procurement to a tighter, more collaborative approach. Following this, we'll investigate the tapestry of products that form SAP's sourcing and procurement portfolio.

Sourcing and procurement is a topic that encapsulates how digital technology has and continues to disrupt long-established ways of doing business. Rather than simply speeding up traditional business processes, digital technology has been a catalyst enabling procurement departments to adopt new relationship models that move beyond arm's-length vendor/supplier relationships and embrace mutually beneficial collaboration based on intelligence networks.

We procure items from a myriad of sources—shops, markets, cafes, restaurants, and online—however, despite the commonplace nature of the activity, finding a consensus as to the lexicon or even the encompassing span of activities for the term "procurement" isn't so straightforward.

To illustrate the point, some organizations "procure" from "suppliers" while others "purchase" from "vendors," some "source," some "transact," and some "buy." Our first task therefore is to wrangle the somewhat elusive term "procurement" into its constituent parts (as shown in Figure 4.1) and establish a common definition that we'll use throughout this chapter, as follows:

- **Sourcing**
  Sourcing refers to processes and activities spanning the initial identification, evaluation, and engagement of suppliers through to the agreement of contracts. Logically, sourcing is a precursor to purchasing.
- **Purchasing**
  Purchasing relates directly to the act of acquisition. It leverages the relationships

and contractual instruments established during sourcing and spans activities from the raising of a purchasing request (or requisition) to the processing of a purchase order (PO) and the final payment of vendor invoices.

- **Procurement**
  As shown in Figure 4.1, many use procurement as an umbrella term encompassing both sourcing and purchasing activities. However, for practical purposes SAP uses the terms "procurement" and "purchasing" almost interchangeably, and therefore within this chapter, we shall do the same.

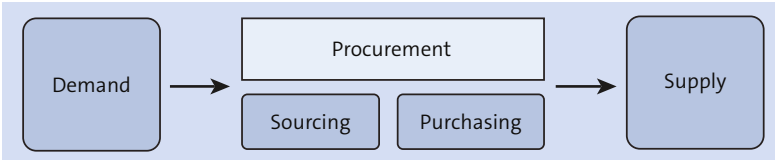

Figure 4.1 Breakdown of Procurement and Its Relationship to Supply and Demand

This chapter will begin by highlighting SAP's solution landscape for sourcing and procurement, before walking through the major sourcing and procurement business processes, digging into some of the key functionality contained within SAP S/4HANA Enterprise Management and SAP Ariba. First, let's check in with our business case.

4.1 Business Case

As a large manufacturing organization that both procures a wide range of stock items and has a sizable network of service providers, procurement featured high on the transformation agenda at Bault Robotical. From a process perspective, procurement was defined as one area that should "fit to standard," meaning that the organization should seek to adopt the standard SAP best practice approach and look to change business processes rather than changing the solution. From a legacy perspective, Bault Robotical already used SAP heavily for its sourcing and procurement functionality with the organization already using SAP Ariba Sourcing and SAP ERP for direct, indirect, and services procurement. Parts of Bault Robotical's business also used SAP Supplier Relationship Management (SAP SRM) for aspects of the procurement cycle, although this was far from being widespread.

Bault Robotical decided that the future landscape for procurement would include SAP S/4HANA Enterprise Management, SAP Ariba (various modules), SAP Fieldglass (for services), and SAP Concur to manage travel and expense purchasing. Following

are a few of the strategic decisions made by Bault Robotical in regard to its sourcing and procurement estate:

- **Stock materials procurement at Bault Robotical**
  The implementation of SAP S/4HANA Enterprise Management was principally to control the procurement of stock materials of which demand was generated from the material requirements planning (MRP) run. While the trigger remained within SAP S/4HANA, the communication of the orders to the vendors and the subsequent control of the inbound process was transferred to SAP Ariba. This necessitated a significant business change effort and working with SAP to move the vendors of Bault Robotical onto the SAP Ariba platform. This move also necessitated a change to Bault Robotical's standard contractual terms to include a clause that any potential vendors would agree to transact through the SAP Ariba platform. Any stock items that weren't triggered by MRP could also be purchased through catalog functionality within SAP Ariba.
- **Indirect material procurement at Bault Robotical**
  It was decided to control all indirect (nonstock) material procurement through the Ariba Network using the catalog functionality to facilitate self-service procurement within the Bault Robotical business. Mobile applications within the SAP Ariba solution also facilitated procurement by Bault Robotical engineers in the field.
- **Contingent labor**
  As part of the overall solution, Bault Robotical decided to control all sourcing and procurement for contingent labor from within SAP Fieldglass (Chapter 12). Although it was noted that some functionality specifically around sourcing events was shared with SAP Ariba, the end-to-end (sourcing to offboarding) functionality offered by SAP Fieldglass, plus the inclusion of a managed service provider, convinced Bault Robotical that the SAP Fieldglass solution was the better fit.
- **Travel and expense**
  Bault Robotical also decided to use both Concur Expense and Concur Travel for its travel and expense process. While this is a topic that isn't covered here, it does form part of the procurement suite and is covered in Chapter 13.
- **Trigger material reservations**
  One gap that Bault Robotical did have was the ability for field engineers to request existing stock through a material reservation (rather than a PO). In this scenario,

Bault Robotical engineers wanted the ability to check stock balances within a specific warehouse or storage depot and request certain materials. While this functionality wasn't available at the time this was written, Bault Robotical, working with SAP, did acknowledge that this functionality was due to be released before the end of 2018, so this is something that Bault Robotical committed to revisiting in the future.

4.2 SAP Portfolio Overview

Having established the key business elements encompassed within procurement, we'll now spend time introducing the SAP products and services that constitute the modern SAP procurement portfolio and some of the key technical enablers that have facilitated the development of this portfolio. Specifically, we'll now discuss SAP S/4HANA Enterprise Management and SAP Ariba in detail while making reference to SAP Fieldglass along the way (we'll discuss SAP Fieldglass in greater detail in Chapter 12).

Out with the Old

From the outset, we should state clearly that the products in SAP's next-generation sourcing and procurement suite that we're about to discuss weren't originally designed to work together, resulting in areas of functional duplication and crossover. From a genealogy perspective, SAP S/4HANA Enterprise Management has its roots firmly planted in SAP ERP (which in practical terms began with R2 in the early 1970s), whereas Ariba and Fieldglass were successful products in their own rights prior to acquisition by SAP in 2012 and 2014, respectively.

Rather than highlighting a definitive delineation as to where the functionality of one of these products ends and the next begins, this chapter offers practical guidance to the advantages and disadvantages of one solution over the other. We'll also discuss and demonstrate how these solutions can be co-deployed in a hybrid manner to exploit the specific benefits of each solution.

4.2.1 SAP S/4HANA Enterprise Management

The procurement functionality present in SAP S/4HANA Enterprise Management is an evolution of functionality developed largely to service the internal needs of the

organization engaged in procurement without much thought being given to the supplier who receives the procurement order. In practice, this means that most of the work done within SAP ERP focuses on creating the correct internal checks and balances to ensure that the end-to-end SAP-based procurement-to-payment process runs smoothly.

As an example, consider the PO. Conceptually, the purpose of the PO is to notify a vendor of goods or services required by the purchasing organization, the date the goods and services are required, and the price to be paid. A PO is quintessentially a "shared" document, meaning that it's equally important for both the procurement organization and the vendor. However, within the confines of SAP S/4HANA Enterprise Management, native options for communicating a PO are very limited, with organizations either printing and posting physical copies or communicating by fax or email. The PO outputted from SAP S/4HANA Enterprise Management is therefore a "dumb" document that can't easily be acknowledged, amended, or rejected digitally unless specific point-to-point integration between the purchasing organization and vendor has been established.

Point-to-point integration allows for individual links to be established on a vendor-by-vendor basis and can circumvent the inherent limitations of dumb outputs from SAP S/4HANA. These integrations can be fairly cumbersome to establish and maintain, however, and due to the time and effort required, they don't lend themselves to a purchasing organization looking for a fluid and agile supplier base. Practically, this limitation has created a cottage industry of departments whose sole job is to validate that vendors have received POs, confirming quantities and dates, and monitoring/amending shipping information.

Apart from the inherent internal focus within SAP S/4HANA, the functionality is aimed more at purchasing rather than sourcing. A few exceptions do exist, and sourcing concepts such as request for quotations (RFQs) are catered for within SAP S/4HANA. From a high-level perspective, however, we can consider complex sourcing to be outside the scope of SAP S/4HANA Enterprise Management.

4.2.2 SAP Ariba

Unlike SAP S/4HANA and SAP ERP before it, SAP Ariba was effectively "born digital." It was conceived specifically as a cloud-based, networked solution designed to facilitate collaboration between purchaser and vendor.

To illustrate the point, let's revisit the PO example. As we've already stated, within SAP S/4HANA and without specific point-to-point integration, the PO is an intelligent document only within the confines of the purchasing organization. However, within a networked solution such as SAP Ariba, the PO is intelligent on both sides of the fence and acts as a shared object that is the basis of automated communication. Steps such as order acknowledgments, order amendments, and advanced shipping notifications are automated and conducted within the SAP Ariba solution itself, and real-time information is provided to both parties.

What's Right for You?

Therefore, right from the outset, we can start to shape our thinking along these two distinct lines: Where the requirement is based solely within the internal processes of the purchasing organization, then SAP S/4HANA Enterprise Management may well contain the requisite functionality. Alternatively, if the focus is based around the effective sharing of information outside of the four walls of the procuring organization, then due to the nature of the underpinning technology, SAP S/4HANA Enterprise Management on its own is unlikely to satisfy the complete requirement. In this case, an organization should look to access the feasibility of a hybrid model combining the functionality of SAP S/4HANA Enterprise Management with SAP Ariba and/or SAP Fieldglass.

The Ariba portfolio encompasses a full range of functionality covering both Sourcing and Purchasing. Indeed, Ariba can run the entire procurement process without interaction with SAP S/4HANA or indeed any ERP solution at all. However as practically speaking as this book is aimed at an SAP audience the lion's share of the discussions will focus on the interaction between SAP Ariba and SAP S/4HANA Enterprise Management.

This being the case we can consider the SAP Ariba Portfolio in three broad sections:

- **Sourcing functionality**
  Sourcing (as outlined at the beginning of this chapter) is a term that encompasses all activities pertaining to the identification of suitable suppliers and the establishment of the requisite terms required for the actual purchase to proceed. Sourcing also includes evaluating suppliers and ensuring that all factors are considered when identifying the most suitable provider of goods and services. We'll discuss sourcing further in Section 4.3.

- **Purchasing functionality**
  The purchasing functionality of SAP Ariba includes all activities concerned with the transactional procurement of goods and services, ideally based upon the centrally agreed terms specified in sourcing. This includes the raising of orders from catalogs as well as processing requisitions created via the MRP process. We'll discuss this further in Section 4.4.
- **The Ariba Network**
  The Ariba Network is an e-commerce platform that connects vendors and customers from around the globe. It's designed to facilitate collaboration and enables self-service and the instantaneous communication of procurement process steps and documents. It's effectively a digital market place where purchasers and suppliers (and, as importantly their individual systems) are fully connected. The Ariba Network is effectively the communication channel for orders, shipping notifications, etc., and can be used as the vehicle to transmit procurement information that has either been generated directly from the Ariba Network or equally from orders that originate from SAP S/4HANA Enterprise Management (for example, stock orders generated by MRP).

Figure 4.2 outlines the constituent parts of the portfolio at a more detailed level.

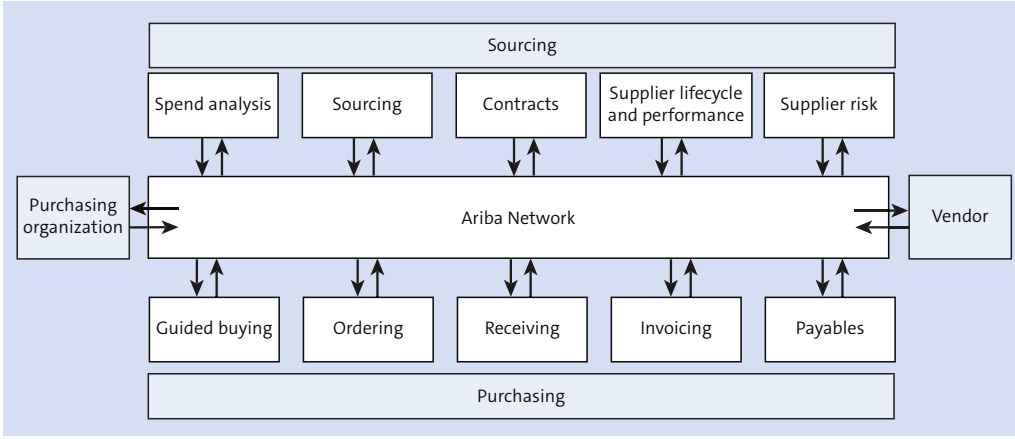

Figure 4.2 Overview of How the Ariba Network Enables Sourcing and Purchasing

4.2.3 SAP Fieldglass

We'll cover SAP Fieldglass and the concept of the "gig economy" in Chapter 12. At this point, however, we'll simply say that SAP Fieldglass is a tool to manage vendors and

individuals performing tasks on behalf of an organization but aren't contracted to that organization in a traditional employee/employer relationship.

In addition, for the purpose of this chapter, we can draw a clear distinction by thinking of SAP Fieldglass as being concerned with the procurement of services rather than materials. With this distinction drawn, we should also acknowledge that, functionally speaking, there is an overlap among SAP S/4HANA Enterprise Management's service management functionality, SAP Fieldglass, and SAP Ariba. Once again, this chapter will shed some light on what functionality sits where and how these solutions can be combined to provide a "best of both worlds" hybrid model.

4.3 Sourcing

Sourcing in its simplest form is a term that encompasses all activities pertaining to the identification of suitable suppliers and the establishment of the requisite terms required for the actual purchase to proceed. Up to now, however, we've treated "sourcing" as a consolidated term, when in actuality, as a process and a strategy, sourcing can look markedly different between businesses and even within the same business We'll now look at some of these different approaches to sourcing while at the same time highlighting the SAP products and functionality most applicable to these differing approaches. We'll start with the most basic approach: reactive sourcing.

4.3.1 Reactive Sourcing

Let's begin by considering the scenario in which it's a hot day, and your children are pestering you for an ice cream. After token resistance, you capitulate and agree. You now have your starting point, your demand.

However, before you can purchase the ice cream, you need to find somewhere to buy it from. Now let's further assume you're near a beach or at a fun fair, so finding a source of the ice cream should be easy with several potential sourcing options (think ice cream van, sweet shop, and café). After you've assessed your potential options, considered the terms (e.g., price and length of the line), and made a final decision about who to buy from, you have, in effect "sourced" the ice cream.

In this very simple scenario, the little sourcing that was done was completely reactive in nature. In this example, the source of supply wasn't identified until the demand was created, and no sourcing work was carried out in anticipation of an expected

demand. While this scenario is simplistic in nature, it's still prevalent within many organizations today.

Even today, many purchasing organizations will only become notified of a requisition at the point it needs to be actioned. At this point, the procurement organization will seek to find a suitable supplier to accommodate the demand, but due to the urgency of this type of demand, the commercial value that the department can add is limited at best. However, in some cases, even after careful consideration of all sourcing options, many organizations may well decide to manage certain material types and services on this ad hoc reactive basis. It may not be possible to justify the effort and cost needed to manage low-cost items that are ordered infrequently on anything other than a reactive basis.

This type of sourcing can in theory be handled within SAP S/4HANA Enterprise Management. Like its predecessor SAP ERP, SAP S/4HANA Enterprise Management contains the functionality required to establish baseline contractual data, which can subsequently be used within the execution of purchasing. This is either in the form of outline agreements or master data, such as purchasing information records that set predefined rules for purchasing certain items off certain vendors. It also allows vendor records to be created that hold the necessary procurement data, such as terms of payment and contact details.

4.3.2 Tactical Sourcing

Beyond reactive sourcing sits tactical sourcing, which can be viewed as a more structured form of sourcing (but still not particularly comprehensive). Tactical sourcing events are once again generally reactive although formal processes, such as RFQs, may be used to try to obtain improved purchasing terms. In this type of sourcing, the commercial effort is relatively one dimensional in nature and, as in our ice cream example earlier, is often concerned almost exclusively with identifying suppliers who can provide the requisite material or services at the lowest purchase price.

This type of sourcing approach also tends also to be accompanied by a siloed standard cost view of the world. For this sourcing approach, the performance of the specific purchaser is evaluated based almost exclusively upon the metric of purchase price variance (PPV). Unfavorable variances are recorded if the actual purchase price exceeds the default standard, and favorable variances occur if the purchase price secured is less. This therefore incentivizes the procurement organization to focus

exclusively on lowering the transaction price and has little thought to wider value-based metrics, such as total cost of ownership (TCO).

In practice, this type of customer/supplier relationship tends to be both arm's length and adversarial with the purchasing organization looking to obtain the lowest possible purchase price while the supplier is simultaneously concerned with "winning the work" and protecting its own margin.

Like reactive sourcing, tactical sourcing can be accommodated within SAP S/4HANA Enterprise Management by utilizing the functionality described previously and by also using the inherent RFQ functionality.

RFQ functionality within SAP S/4HANA Enterprise Management can be used to invite vendors and suppliers to submit quotes for items required by the purchasing organization. The RFQ contains the estimated quantities to be purchased, the date by when the material needs to be delivered, and a deadline outlining when the supplier must submit the response (Figure 4.3).

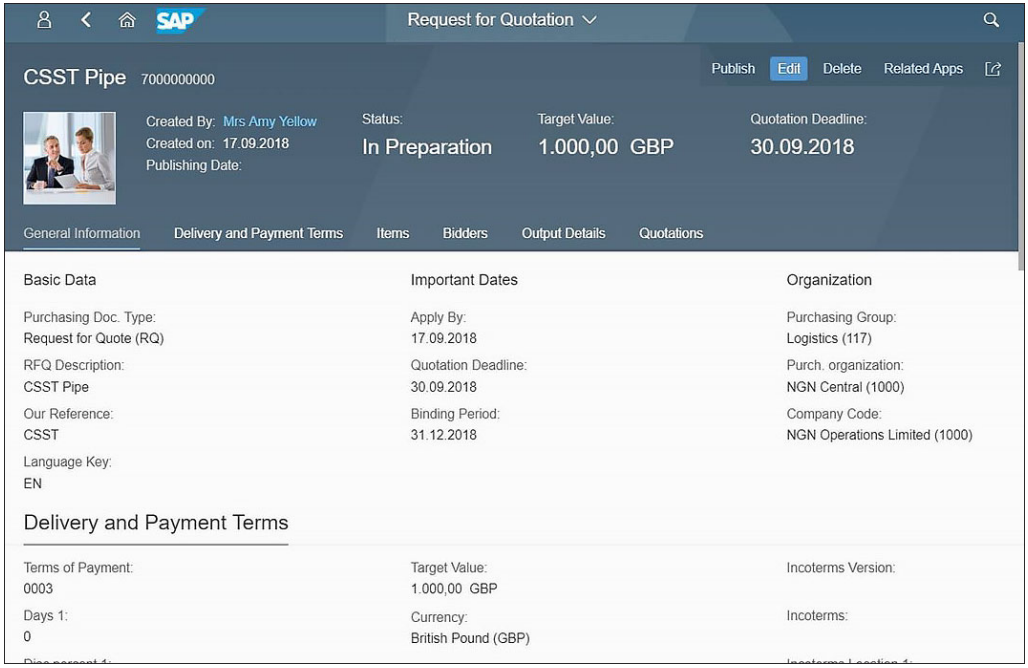

Figure 4.3 Example of an RFQ in SAP S/4HANA

After vendors submit the quotations, the information is entered into SAP S/4HANA and compared using a price comparison list. The winning bid can then be turned into a purchasing information record, and rejection letters can be created for the unsuccessful suppliers.

However, while this explanation may appear to be a fairly straightforward approach for managing a tactical sourcing scenario, keep in mind that all SAP S/4HANA Enterprise Management functionality is predominantly inwardly focused, and therefore all interactions between the purchasing organization and vendor are conducted manually. In addition, note that SAP S/4HANA doesn't help in the identification of potential vendors nor provide any formal method of bid management. Therefore, while these limitations may be accommodated within a tactical sourcing scenario, it sits unhappily with a more complex strategic sourcing strategy.

4.3.3 Strategic Sourcing

Unlike reactive and tactical sourcing, strategic sourcing as a concept is proactive and endeavors to preempt the needs of the wider purchasing organization and have optimal vendor relationships prior to any communication of actual demand. Strategic sourcing aims to provide a holistic understanding of both the needs of the complete business and information regarding the current levels of spend. Unlike the previous two examples, strategic sourcing can't take place in a vacuum and depends on collaboration both with vendors and across the procurement organization and the wider business.

The organizational challenge that this latter collaboration creates should not be underestimated with departmental structures, reporting lines, bonus structures, and many other factors creating and sustaining silos within the organization. As can be seen from the previous two sourcing scenarios, many organizations and departments will only involve the purchasing organization at the last minute, and changing this behavior often involves a conscious business effort alongside the formulation of a truly cross-functional team to assess areas where a strategic sourcing scenario approach is applicable.

Once formed, this team will walk through a variation of the following six sequential elements:

1. Profiling the category
2. Selecting the sourcing strategy
3. Generating the supply portfolio

4. Selecting the implementation path
5. Negotiating and selecting supplier
6. Manage vendor lifecycle and performance

These six elements are an adaption from the seven-element model developed in 2001 by the management consulting firm AT Kearney. Although the list has been refined and adapted by various consultancies, it remains a pragmatic and widely recognized overview of the tasks involved in strategic sourcing.

From an SAP portfolio perspective, we'll be breaking down strategic sourcing into the following SAP Ariba solutions:

- SAP Ariba Spend Analysis
- SAP Ariba Sourcing
- SAP Ariba Contracts
- SAP Ariba Supplier Lifecycle and Performance
- SAP Ariba Supplier Risk

We'll now discuss each step in more detail.

Profile the Category

This initial step in strategic sourcing is itself subdivided into three logical sections, all of which are concerned with gathering intelligence from various forms of analysis. This intelligence gathering is of paramount importance to ensure that the correct foundations are set and to ensure that the organization adopts the optimal sourcing strategy (step 2) and full knowledge of specific suppliers is available when it comes to supplier negations (step 5). The three elements are as follows:

- **Spend analysis**
  The purpose of a spend analysis is to obtain a clear understanding of the internal spend of the complete organization by, for example, certain vendors, commodities, and cost centers. Practically, this often begins with a company-wide collation of all the existing contracts that the supplier has so a complete picture of spend can be developed based on financial value, locations, pricing, terms and conditions, and which sources are used most frequently.

  SAP provides the following two key solutions for analyzing its spend:

  – SAP Spend Performance Management: As neither an SAP S/4HANA Enterprise Management solution nor an SAP Ariba solution, SAP Spend Performance

Management is on-premise analytical reporting tool based on SAP Business Warehouse (SAP BW) that allows spend data from multiple SAP and non-SAP sources to be consolidated and reported through predefined metrics that a user accesses via a web-based frontend. These metrics are based on SAP best practices, which are, in turn, based on industry best practices and are designed to offer a standard out-of-the-box analysis.

- SAP Ariba Spend Analysis: This SAP HANA solution based on software-as-a-service (SaaS) aggregates, classifies, and allows for the enrichment of spend data while also making this data available via an analytic tool. SAP Ariba Spend Analysis facilitates the capture of compliance and savings KPIs by consolidating spend across all of the enterprise's purchasing systems in an organization's landscape. Compliance KPIs are incorporated to understand what has already happened, such as vendor compliance, and contract level compliance. Savings KPIs forecast potential opportunities for ordering and invoicing consolidation.

- **Needs analysis**
  Needs analysis as a process demonstrates why strategic sourcing must be done through a cross-functional team and not exclusively by the procurement department. A needs analysis involves gaining a thorough understanding of the business-wide need, how the business feels about a particular supplier, and what improvements the business feels could be made to either the product or the service. By conducting a needs analysis, a qualitative context is added to the previously discussed spend analysis.

- **Supply market analysis**
  Having gained both quantitative and qualitative information about the vendor, the idea here is to understand the supply market that they operate in by determining the main competitors, their specific cost pressures, and the current industry trends. It's also important to try and understand as much as possible about the health of the vendor's business together with starting to gain an understand of which other suppliers could provide similar products or services.

  Together with collating pertinent information pertaining to an organization's spend, SAP Ariba Spend Analysis also provides functionality to support supply market analysis by enriching spend data with market intelligence both from the Ariba Network itself and also (as an optional extra) from Dun & Bradstreet, a Fortune 500 company that provides commercial data to businesses on the credit history and risk exposure, among other things, of more than 265 million companies.

This enrichment includes elements such as financial indicators, company parentage, and industry designations.

What's Right for You?

Enriched parentage can identify where multiple vendors belong to the same parent company and therefore present potential scope for commercial rationalization, whereas financial insight can help manage risk and provide useful context to the health of the vendor's business.

Additional enrichment, available at an extra cost from Dun & Bradstreet can encompass factors such as the vendor's diversity and environmental considerations. These may be critical factors within local legislative environments; for example, businesses in South Africa have to meet a number of government-mandated targets around company ownership and diversity. Additionally for companies that have environmental credentials and reputations at stake, it will be critical to ensure that their supply chain reflects their aspirations and ethos.

Select the Sourcing Strategy

The next step is to define the sourcing strategy that should be assigned to a particular product or group of products. To achieve, this many organizations will classify the products into one of the following four items:

- **Strategic items**
  Strategic items are the most important items for a procurement organization, and ensuring a regular supply of these items should be a primary focus. To accomplish this procurement organizations, organizations can adopt the following sourcing strategies:
  - Product specification improvement: This involves working with the supplier to tailor the product specifically to meet the needs of the purchasing organization.
  - Joint process improvement: The procurement organization and the vendor consciously work together to provide a better and mutually beneficial service.
  - Relationship restructuring: The procurement organization and the vendor establish a long-term partnership that provides the vendor assured demand and should provide the purchasing organization preferred pricing and a greater degree of confidence of supply.

- **Leverage items**
  This is the next most important class of products. In common with strategic items, leverage items are very important to the overall profitability of the organization, but unlike strategic items, there is a low supply risk, meaning the product in question is often a standard item that can be supplied by multiple suppliers. Appropriate sourcing strategies for products within this classification include the following:
  - Volume concentration: Looking to collectively bulk buy the requirements for the whole organization centrally to gain leverage with the supplier.
  - Best price evaluation: Negotiating to achieve the lowest possible price. For items in this classification, an organization may consider developing new vendors or expanding their supplier network often through pursuing sourcing opportunities in low-cost countries or by exploring outsourcing opportunities.
- **Bottleneck items**
  These items have a low potential impact on the overall profitability of the organization but are either single sourced or supplied by a very small number of suppliers. Procurement approaches here follow broadly the approach taken with strategic items.
- **Noncritical items**
  These items have a low impact on the potential profitability of the overall organization and carry a low supply risk. Common purchasing approaches for these items are usually with items classified as leverage items.

From an SAP perspective, SAP Ariba Spend Analysis once again supports this activity with reports such as the Supplier Fragmentation Report, Supplier Footprint Report, and Spend Concentration Report, which are intended to clarify scenarios where organizations have dependencies and bottlenecks with certain suppliers.

After these two first steps have been achieved, and a procurement organization has a sound understanding of its internal spend, its needs, the supply market, and a clear direction in terms of procurement strategy, the next step is to engage suppliers.

Generate the Supplier Portfolio

This step is exclusively concerned with widening the procurement organization's supplier base and identifying all viable suppliers for the product to be sourced. This is done by incorporating the needs analysis performed in step 1 to develop the criteria

for supplier selection. At this point, a portfolio of potential suppliers should be established with all potential suppliers included. To make this identification of suppliers as simple as possible, SAP Ariba offers SAP Ariba Discovery, which is a service that allows buyers to identify new suppliers and read profile information and feedback.

What's Right for You?

From a buyer perspective, searching SAP Ariba Discovery is free; for suppliers, they have the choice of three subscriptions options: Standard, Advantage, and Advantage Plus. A Standard subscription gives you free access to SAP Ariba Discovery, the ability to exchange messages with buyers (limited to 20), and access to respond to requests for information (RFIs)/RFQs on a pay-per-response basis. The Advantage subscription increases the message limit to 50, removes the response fees, and adds a premium profile for an annual subscription. Advantage Plus provides unlimited messaging, priority support, expert advice, and networking opportunities, again on an annual subscription basis.

Select the Implementation Path

The purpose of this step is to define the mechanics of selecting a supplier from the portfolio. Common approaches are littered with three letter acronyms, such as RFI and RFP, and are often grouped together under the umbrella term RFx. The approach an organization takes will depend on the desired outcome, such as information, a firm proposal, or a detailed price bid. Let's explore the major approaches:

- **Request for information (RFI)**
  An RFI is a structured process whereby information is sorted from suppliers prior to a formal sourcing event. It's a structured process in which many potential suppliers can be reduced to a list comprising only organizations that are able to fulfill the requirements of the procurement organization. An RFI is typically followed by an RFP or RFQ.
- **Request for proposal (RFP)**
  An RFP is a means by which a procuring organization can seek and receive detailed and comparable proposals from suppliers for products and services. It should be a comprehensive document that provides the requisite level of detail for the procurement organization to make an accurate and informed sourcing decision.

Note that in a situation where step 3 only generates one viable supplier, an organization may dispense with this step altogether and choose instead to negotiate directly without issuing an RFP.

The setup and management of RFx processes are core elements of the SAP Ariba Sourcing solutions of which there are currently two:

- **SAP Ariba Start Sourcing**
  This basic version of SAP Ariba Sourcing is free sourcing software (maximum of two users creating two sourcing events per month) that allows a purchasing organization to quickly create and manage sourcing events, including wizard- and template-based RFxs and auctions. Once created, these events can subsequently be published to SAP Ariba Discovery (discussed earlier) where new suppliers can find and respond to them. SAP Ariba Start Sourcing can also help to manage communications pertaining to these events on a one-to-one or one-to-many relationship.
- **SAP Ariba Sourcing**
  This includes the same features of SAP Ariba Start Sourcing together with offering additional functionality, such as project management and workflow features needed for the organization of more complex sourcing events.

Negotiate and Select Suppliers

This step involves using all the intelligence that has been garnered in the previous steps to select a supplier. Understanding the supplier's current bargaining position (supply market analysis) will provide invaluable insight when conducting negotiations and when it comes to accessing the relative bargaining power of both parties.

After a vendor has been selected, SAP Ariba Contracts can be used to automate and accelerate the entire contract lifecycle. SAP Ariba Contracts removes the issues relating to the misplacement and mismanagement of paper contracts by having a contract as a shared document that is always available and always accessible to both parties.

Manage Vendor Lifecycle and Performance

For every organization, the scenario of onboarding new suppliers and discontinuing old ones is common, as is the desire to understand the performance of a vendor. This final step within the strategic sourcing scenario concentrates on the mechanics of

both managing suppliers from onboarding to phaseout and the ongoing monitoring of the vendor throughout the lifecycle.

When considering supplier lifecycle and performance, SAP has developed the SAP Ariba Supplier Management portfolio, which covers lifecycle management and supplier risk and consists of three solutions:

- SAP Ariba Supplier Lifecycle and Performance
- SAP Ariba Supplier Risk
- SAP Ariba Supplier Information and Performance Management

Out with the Old

Until recently, the default solution for managing supplier onboarding and performance was SAP Ariba Supplier Information and Performance Management; however, as this solution has now been superseded by SAP Ariba Supplier Lifecycle and Performance, it has been omitted from this chapter. It should be noted that SAP Ariba Supplier Lifecycle and Performance only works with the business partner functionality and therefore will only work with legacy SAP ERP systems if vendors have been converted to business partners.

The idea behind the portfolio is to provide a single view of all information relating to a vendor in one place and in a manner that is intrinsically linked to SAP S/4HANA Enterprise Management.

Let's unpack SAP Ariba Supplier Lifecycle and Performance and SAP Ariba Supplier Risk further:

- **SAP Ariba Supplier Lifecycle and Performance**
  Provides a unified view of all information pertaining to a supplier by combining supplier information (onboarding), qualification segmentation, vendor performance, spend, and risk data in one place. SAP Ariba Supplier Lifecycle and Performance manages the onboarding of a supplier both from SAP Ariba and backend SAP S/4HANA Enterprise Management perspectives, meaning that after a supplier is approved within SAP Ariba, it's synced with SAP S/4HANA Enterprise Management (through standard connectors that are soon to be superseded) and is ready to the purchased against within SAP ERP or SAP S/4HANA.
- **SAP Ariba Supplier Risk**
  Understanding and monitoring suppliers' risk is an important factor in deciding whether and how to do business with them. SAP Ariba Supplier Risk integrates

seamlessly with SAP Ariba Supplier Lifecycle and Performance and provides continuous risk exposure tracking for risks such as the following:

- Financial: Supplier insolvency/bankruptcy, counterfeiting, and theft
- Operational: Supplier nonperformance, shortages, IT security breaches, and infrastructure outages
- Geopolitical: Natural disaster and geopolitical instability
- Reputational: Child labor, safety lapses, and poor working conditions
- Regulatory: Bribes, Sarbanes Oxley (SOX) violations and environmental violations

We've now completed the overview of sourcing, having outlined strategies ranging from simple reactive sourcing to the far more complex strategic sourcing. Now that we have these foundations in place, we can move ahead to looking at the next procurement topic: purchasing.

4.4 Purchasing

The purpose of this section is to detail the SAP solutions available for purchasing. For the purpose of this section "purchasing" involves the steps relating to the transactional procurement of goods or services. This procurement is facilitated by sourcing activities that have already established relevant suppliers and contractual terms that define the rules of the commercial engagement.

A simple purchasing scenario involves the following steps:

1. Purchase request
2. Purchase
3. Acknowledgment and shipping notification
4. Receiving
5. Invoicing

The following sections outline these key process steps while also highlighting the factors that materially affect which member of the SAP procurement portfolio is likely to be suitable for direct material purchasing, indirect material purchasing, and services purchasing.

4.4.1 Purchase Request

As previously discussed, the purchasing process begins with a demand that is subsequently turned into a request to purchase, which generally takes the form of a purchase requisition.

A purchase requisition is purely an internal document that outlines a desire to purchase specific goods or services. It's neither legally binding nor intended to be communicated to a supplier. A purchase requisition details the required quantity, product number (or description), and a date that the requestor would like the goods or services to be delivered. Once created, it's then generally routed to an approver who may decide either to approve or deny the request. If the vendor is known at this point in time, the approver can also confirm that the desired purchase is in line with the relevant sourcing infrastructure (contracts, preferred suppliers, etc.) outlined in Section 4.3 of this chapter and compliant with company procurement policy.

Although this process step sounds simple, the origin and type of demand will largely dictate which SAP solution should be used to create and subsequently process the purchasing request. A common way of delineating the demand is to separately segregate demand emanating directly from a manufacturing process from demand that is indirectly related to the manufacturing process—that is, between direct procurement and indirect procurement.

For most organizations, direct procurement demand is generated automatically within an ERP system such as SAP S/4HANA Enterprise Management and more specifically from the MRP process. (MRP and manufacturing as a topic are discussed in Chapter 5.) Therefore, unlike for indirect procurement, an organization will generally have all the necessary information (e.g., material number, specifications, etc.) required to procure from a vendor. In addition, if the sourcing tasks described in the previous section have been followed, very little additional effort is needed during the purchase requisition stage. Indeed, often when a material demand emanates from a direct source, MRP will create the initial planned order (which is a step before purchase requisition) based on the manufacturing plan. If the source of supply is already known, which is often the case, the purchase requisition becomes almost irrelevant and may even be converted to a PO automatically via a scheduled job.

Functionality for controlling direct procurement has long been a staple of SAP ERP and continues to be in SAP S/4HANA Enterprise Management. For this reason, many organizations continue to use SAP S/4HANA Enterprise Management as the tool to generate (and subsequently process) purchase requisitions for direct materials.

However, although processing of direct material demand has long been an established and robust process within SAP ERP (and subsequently SAP S/4HANA Enterprise Management), the same can't be said for the processing of indirect material demand. The reasons for this are twofold: First, direct materials are almost always set up as material masters within SAP S/4HANA Enterprise Management, which means the attributes of the material are known, and sourcing master data, such as contracts, schedule agreements, purchase information records, and source lists, can be created and made visible to MRP. However, indirect spend often comes from items that aren't created as material masters, so they can't easily be assigned to sourcing master data elements, nor can MRP generate demand. In this latter scenario, the purchasing requisition takes on a level of importance that it doesn't have when demand is generated directly.

It would however be erroneous to suggest that SAP S/4HANA can't deal with indirect purchases or that purchase requisitions can't be generated for indirect goods. Indeed, the purchasing steps in the process are identical. Material masters can be generated for indirect materials (using material types specific to indirect materials), and contracts and purchasing information records can control indirect material spend in exactly the same way as direct material spend. In fact, in the real world, the problem isn't within the capability of the software but rather the nebulous nature of items that fall within the category of "indirect." The main gap comes with unlike direct materials, for example, other regulated materials (ORM) with demand that is often sporadic, immediate, and encompassing an almost infinite number of products and vendors. This in turn means that many purchases for ORM tend to be maverick in nature, that is, falling outside of the control of procurement and thus often outside of the scope of approved company buying policies. For this reason, many of the same organizations that trigger direct materials purchasing within SAP S/4HANA Enterprise Management should be able to gain more control over indirect materials, such as ORM, by using the functionality within SAP Ariba.

SAP Ariba Buying contains the *guided buying* functionality, which enables a member of the purchasing company to search for products from a unified catalog that contains only items from approved vendors. Company buying policies are "baked in" to this functionality, and, crucially, it doesn't need a material master to exist in SAP ERP to be able to control the request. In tandem with guided buying, SAP Ariba Buying allows access to a controllable business-to-business (B2B) marketplace for scenarios when an item can't be found in the company catalog. Using this platform, business users can search the entire SAP Ariba Spot Buy catalog, filtering results by category,

brand, and price. Configurable business rules and workflows can also be used to enforce corporate policies and approve requisitions.

To create a requisition within guided buying or SAP Ariba Spot Buy, a user simply adds the product to a shopping cart and then checks out. At this point, the approver will be notified that a requisition has been created.

4.4.2 Purchase

If the request to purchase was approved in the previous step, then these requisitions can be converted to a PO, which, once communicated to a vendor, becomes a legally binding document and triggers the acquisition. The order must contain the terms of the purchase, including such items as price, quantity, and delivery date. In our SAP Ariba example, after the item has been approved, it's created both within SAP Ariba and within the accompanying SAP S/4HANA system. It's also communicated to the vendor directly via the Ariba Network.

Within SAP S/4HANA, a purchase requisition can be converted to a PO either en masse or individually, and generally the PO (rather than the requisition) will be subject to the approval process, which is based on the value of the item being purchased. After the PO has been approved, the output will be generated, meaning that it's now capable of being communicated to the vendor. This, as has previously been discussed, is where SAP S/4HANA Enterprise Management used in a standalone scenario faces challenges as communication to a vendor needs to be done either using legacy means, such as print and mail, email, or fax, or by leveraging point-to-point integrations, such as Electronic Document Interchange (EDI). However, under a hybrid model, an order that up until this point hasn't touched SAP Ariba can be communicated to the vendor through the Ariba Network. The result of both processes at this point is therefore the same: POs created in SAP S/4HANA and SAP Ariba and communicated directly to the vendor via the Ariba Network.

4.4.3 Acknowledgment and Shipping Notifications

Once communicated from the purchasing organization, a vendor may acknowledge that it has received the order and also confirm that the request quantity of the material or nature of the service can be supplied under the terms stipulated within the PO. In addition, the vendor may, either immediately or at a later point, create and transmit a shipping notification to the purchasing organization to notify the latter that

the material on the PO has been shipped. From the procurement organization perspective, this information isn't only visible within SAP Ariba but is also updated within SAP S/4HANA. This is a significant step forward because while SAP S/4HANA and SAP ERP have long had the ability to record both order acknowledgments and shipping notifications with the PO, in practice, this was subject to the same frailties already discussed. In fact, unless a point-to-point integration exists, then this information has to be entered manually by a member of the procurement organization following a telephone conversation, email, or fax. However, in common with the communication of the PO, vendors can quickly enter acknowledgments and shipping notifications into SAP Ariba, and this information is then updated directly within the SAP S/4HANA system of the purchasing organization.

4.4.4 Receiving

When goods physically arrive, the purchasing organization will perform a goods receipt to confirm that the material has arrived and also to confirm that it's the requested product, in the required quantity, and at an acceptable quality. In terms of a process in SAP, a goods receipt for direct materials can be recorded within SAP S/4HANA or SAP Ariba as part of the goods in process, but it must be duplicated in the other system.

4.4.5 Invoicing

The vendor will send an invoice requesting payment for the goods or services provided, which will be processed by the purchasing organization (as shown in SAP Ariba in Figure 4.4). During this activity, a three-way matching process is usually employed to ensure that the three key documents in the process (PO, goods receipt, and vendor invoice) match. Assuming that the invoice matches the PO and the goods receipt, the payment will be processed (generally by an organization's accounts payable department).

Traditionally, invoices are received either by mail or by email, making the entering, checking, and payment processes complex and time-consuming. To overcome this issue, SAP introduced SAP Invoice Management by OpenText, which is an on-premise solution that contains various branches of functionality to facilitate faster invoice processing. SAP Invoice Management by OpenText contains the OpenText Invoice Capture Center (ICC), which houses optical character recognition (OCR) functionality

that allows "dumb" invoices to be scanned automatically, stored in a document repository, and converted to a machine-readable format. SAP Invoice Management by OpenText also aids in the processing of these invoices by identifying invoice discrepancies and duplications automatically and routing them directly to the correct specialist. Within SAP Invoice Management by OpenText, all invoices are subjected to a defined and documented set of business rules, and the actions that a user can take (e.g., amend purchase price, goods receipt quantity, etc.) are linked to specific roles that guarantee the requisite segregation of duties. SAP Invoice Management by OpenText also contains a mobile app that enables invoice approvals to be executed on a mobile device.

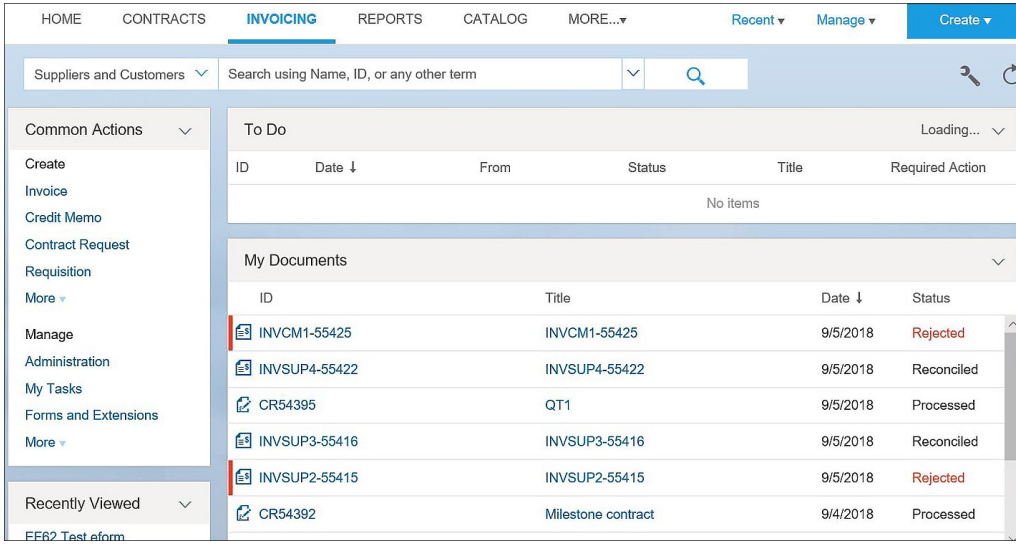

Figure 4.4 SAP Ariba Invoicing Screen

As mentioned, SAP Invoice Management by OpenText is an on-premise solution and corresponding SAP Ariba functionality also exists. Note that the very nature of the Ariba Network removes two of the principle hurdles that SAP Invoice Management by OpenText was designed to overcome: the manual entering of dumb invoices and issues caused by invoices that arrive prior to a goods receipt taking place. The first hurdle is overcome because all documents flowing from SAP Ariba to SAP S/4HANA Enterprise Management and back again are intelligent and automatically created as live documents within SAP Ariba and SAP S/4HANA. Secondly, when an invoice is

presented prior to goods being receipted, the SAP Ariba network contains configurable business rules that ensure (among other things) that documents can't be exchanged out of sequence, meaning that SAP Ariba won't allow an invoice to be created and sent to the purchasing organization before the prerequisite goods receipt has taken place.

However, to further streamline the process, SAP introduced Ariba Invoice Management, which not only deals with the invoices submitted through the Ariba Network but can also be used with invoices received via more traditional channels. The solution automatically facilitates the processing of invoices that match the corresponding POs by allowing payment to be made directly from SAP S/4HANA. Invoices with exceptions are sent back to vendors via the Ariba Network for correction and resubmission. Finally, after payment is executed within SAP S/4HANA, SAP Ariba Invoice Management links the payment to remittance advice and allows vendors to reconcile their payments.

4.5 Services Procurement

Until this point, almost all of the focus has been on material purchasing, while service procurement has been somewhat neglected. However, with the advent of the "gig economy" and a trend toward outsourcing, effective processes and systems to manage service providers and outsourced operations are more important than ever before.

Put simply, the gig economy means contracting with third parties to perform a specific piece of work or "gig."

Digital Disrupter

Digital disrupters such as Uber, TaskRabbit, and Deliveroo are often cited as pioneers of the gig economy, but, in reality, it's a concept that has long existed (as any SAP contractors reading this book can attest to!).

This type of engagement appears to have increased dramatically in recent years, and although finding concrete numbers is difficult, it's estimated that within the United States, for example, 53 million contingent workers exist, equating to 34% of the US workforce. Estimates are that by 2020, this percentage may well exceed 40%. The

effect of this new trend on businesses means that more and more work is being carried out by vendors and individuals external to the organization but who need to be controlled and managed as if they were internal resources.

Added to the emergence of the gig economy is the conscious decision by many organizations to outsource many business processes. Drivers for this outsourcing trend include cost reduction, a desire to focus on core business functions, and the need to address capacity issues. Other organizations actively embrace outsourcing as a way to drive transformational change and improve business results.

To illustrate this point, let's consider the example of apparel and footwear giant Nike. It maintains a healthy proportion of the footwear industry and counts its sales in multiples of billions of dollars. It's also an example of an organization, and reflection of an industry, that has truly embraced outsourcing. From a manufacturing perspective, Nike products are produced in more than 700 factories across 42 countries and distributed from a network of about 60 distribution centers. However, Nike owns no factories nor directly engages in manufacturing of any sort.

With factors such as the gig economy and the global prevalence of outsourcing, the need for organizations to effectively collaborate and obtain requisite oversight of vendors who provide services has become a key focus for procurement (and HR) departments around the globe.

From a procurement perspective, SAP offers three solutions to services procurement:

- SAP S/4HANA Enterprise Management
- SAP Ariba
- SAP Fieldglass

However, before we go into each of these solutions in more detail, it's worth noting that there is a crossover in terms of functionality offered. As mentioned elsewhere in this book, both the Ariba and Fieldglass solutions have been acquired by SAP, so which solution is strategic to SAP moving forward is unclear.

In addition, because SAP Fieldglass is discussed in detail in Chapter 12, we'll save that conversation for later.

4.5.1 Services Purchasing

SAP S/4HANA Enterprise Management can facilitate the purchasing element of service management; that is, it doesn't contain any HR-related functionality, such as

onboarding capabilities that are present in SAP Fieldglass. The purchasing process for services is almost identical to the process for goods with the key exception that rather than entering a goods receipt, the vendors and contingent workers "confirm" the activities they have performed into a service entry sheet (see Figure 4.5). This service entry sheet is then routed for approval by a member of the purchasing organization. Assuming that the service entry sheet is approved, the invoicing cycle continues per the material purchasing scenario.

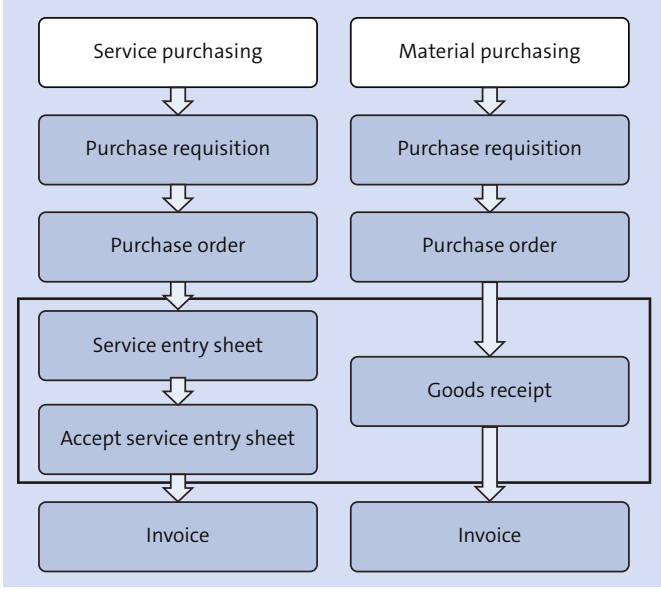

Figure 4.5 Process Overview Outlining the Differences between Service and Material Purchasing

4.5.2 Services Processing

SAP Ariba's services procurement functionality aims to facilitate the procurement and subsequent processing of services. In common with the SAP S/4HANA process outlined previously, the main consideration with services processing is ensuring that the third-party vendor (or individual) is paid in accordance to the work performed and that these costs are correctly attributed to the requisite internal cost object.

Let's take the example of a field engineer and imagine that all employees are obliged to fill in a time sheet. By doing this, their internal costs are attributed to the relevant

cost object (e.g., a work order, work breakdown structure [WBS] element, etc.), meaning the cost of performing that specific piece of work is captured accurately. In addition, this information can also feed into payroll to allow considerations such as salary and overtime to be calculated.

Now if this work is performed by an external contractor, the same mechanism isn't used for allocating time to a cost object nor for ensuring that the invoice submitted is correct.

SAP Ariba's services procurement functionality enables the management of these considerations together with enabling the hiring and tracking of candidates.

In functionality akin to SAP S/4HANA, SAP Ariba enables the use of service sheets upon which contractors enter time against a specific cost object. SAP Ariba then turns this time sheet into an invoice, which effectively links the work performed (and hours/days approved) into a cost against a cost object. To complement this functionality, SAP Ariba also provides expense sheets that, once again, convert information entered by the third party (in this case, expenses) into a linked invoice.

4.6 The Road Ahead

Procurement is a microcosm for how businesses will develop within the next decade. For years, the procurement process has remained largely unaltered and has been reliant on human intervention to fill in gaps that the technology could not accommodate. For this reason, interactions between purchasing organizations and vendors at every level of the procurement process have required phone calls, emails, and even the postal service. This means that still today, many organizations have whole departments dedicated to performing manual tracking and communication of documents and process steps that should, but could not be in the past, automated and digitalized.

The advent of digital networks underpinned by the Internet has finally overcome this deficiency, and today organizations should be looking at how procurement processes should change to embrace this step change. We shouldn't forget, however, that humans aren't simply one-dimensional interfaces, and together with the manual tasks that these departments perform, they also provide an often much-needed safety net to ensure that errors in data and issues elsewhere in the supply chain are rectified prior to being converted into legally binding agreements with vendors. Therefore, organizations need to be fully aware of the burden of raising master data

accuracy and ensuring compliant processes that automation brings with it elsewhere in the business. To put it in simple terms, automating a process that is founded on poor data and noncompliant processes will emphatically cost a procurement organization far more than a manual process that has the safety net of human interaction.

After the complete procurement supply chain has been automated and networked, things can really start to get interesting and encroach further into areas currently performed by humans.

Chatbot technology is beginning to become more prevalent both in B2B and B2C scenarios. In March 2017, Ariba announced that this functionality was being developed for future inclusion into the SAP Ariba suite.

SAP Ariba specifically pointed to the almost constant back-and-forth communication between purchasing organizations and vendors when invoices fail a three-way match, causing a buyer from the procurement organization to reject it and as a result delaying payment to the supplier and a wastage of time generally on the telephone trying to come to a resolution.

SAP Ariba's bot technology is intended to have the ability to learn about a company's policies and procedures and use its requisite intelligence to identify and relay causes of such mismatches either to humans or other bots within other organizations.

SAP Ariba aims to make its procurement bot available as part of a portfolio of bot applications that SAP is developing by the end of the year.

Let's next consider the Internet of Things (IoT), which feels like it has been around for a while yet should have a dramatic impact within the next few years. After an organization has fully linked the procurement supply chain, it can really begin to leverage the opportunities inherent in IoT. Imagine the simple purchasing scenario previously discussed and consider how it could look by incorporating IoT and procurement networks that exist today:

- A bin in a warehouse (managed on a simple min/max lot size level) understands that it needs to replenish.
- A purchase requisition is created automatically and reviewed by AI and machine learning capabilities to look for fraud or violations of company policy.
- Once approved, the PO is automatically routed to the vendor for confirmation.
- The vendor's ERP system performs an available-to-promise (ATP) calculation, accepts the order, and sends a confirmation back to the purchasing organization.
- When the items are physically shipped from the warehouse, IoT capabilities send an advanced shipping notification to the purchasing organization's ERP system.

- The ERP system constantly communicates with the goods in transit to work out (based on current traffic conditions, etc.) the time that the goods will arrive at the designated location.
- When the goods arrive, they are automatically prereceived.

This simple scenario has no human interaction at all and is achievable with technology that exists today. Far from being a vision of a distant future, it's likely that some forward-thinking organizations already have this type of functionality today and highly likely this type of process will be commonplace within the next five years.

Having gone into some depth around sourcing and procurement, we'll now focus on one of the main consumers drivers for procurement: manufacturing.

Chapter 5
Manufacturing with SAP S/4HANA

This chapter outlines how SAP solutions support and enable modern manufacturing processes, including planning, executing, and ensuring production quality.

From pens to planes, manufacturing is a key part of the global economy, and the solutions that support manufacturing have developed alongside the manufacturing processes and techniques that enable the mass production of complex products unthinkable a few decades ago.

Manufacturing companies can be broadly categorized into discrete, repetitive, or process manufacturers, and SAP S/4HANA is built to support all three using functionality found in the core SAP S/4HANA Enterprise Management product and additional solution components. The three types of manufacturing can be defined as follows:

- **Discrete manufacturing**
  This can be thought of as the production of distinct items, meaning items that are individually countable, identifiable by serial numbers, and measurable in distinct units rather than by weight or volume. Items manufactured via a discrete process tend to be higher in value and produced in lower volume. One way of thinking about the discrete manufacturing process is by considering if the finished product could be (theoretically, at least) disassembled into its constituent parts. For example, an airplane engine could be disassembled whereas a chocolate bar or specific medicine could not.
- **Repetitive manufacturing**
  This is defined as the process of producing goods through the same production sequences and often is fulfilled through automated manufacturing techniques. The technique is usually employed to mass produce items over long production runs, where economies of scale can be employed to reduce costs and improve efficiencies. The automotive industry, which requires a large number of identical parts for car assembly, is often linked with this type of manufacturing.

- **Process manufacturing**
  Unlike discrete manufacturing where the output can be disassembled, process manufacturing is generally used to define the production of goods by combining ingredients or substances using a formula or recipe. Goods produced through a process manufacturing production method generally require a thermal or chemical conversion with heat, pressure, or time and, as a result, typically can't be disassembled. This definition encompasses such items as pharmaceutical products and confectionary.

Having outlined the three general types of manufacturing, we'll now further subdivide manufacturing into the three phases that will be used throughout this chapter:

- Planning the manufacturing process
- Manufacturing execution
- Checking the quality of the manufacturing process and delivery to the next stage of the supply chain process

After taking a look at our case study, we'll provide an overview of the SAP portfolio in relation to manufacturing, address the three phases of manufacturing just defined, and finally take a look at the road ahead for manufacturing with SAP.

5.1 Business Case

At its core, Bault Robotical is a manufacturing company producing a number of products, ranging from large, complex items to lower complexity and lower cost mass-produced items. For the more complex items, the company also manufactures the finished items and spare parts required for maintenance and repair of the items during their lifetime in service. A separate business entity also manages customer returns and repairs, and there is tight integration between the two businesses.

Unlike the scenario for mass-produced products, the initial demand for the complex robots to be manufactured will come from a firm customer sales order raised in SAP S/4HANA identifying the model and quantity required of the finished product. The sales order will also hold the customer details, pricing, and delivery schedule, which ultimately drive the manufacturing and assembly plan. The sales order will also determine the planning strategy for the product, which will dictate that the material is either treated as make-to-order (MTO) or engineer-to-order (ETO). Simply put, this

decision will be dictated by the level to which the robot is designed and built around the specific requirements of the individual customer.

Within Bault Robotical for finished goods, an SAP project will then be created to drive production and assembly demand of all finished goods as well as the production of any spare parts that are part of the sale. If the sales order is for a spare part only, then the sales order is used to drive the demand on the production plant.

For project-led manufacturing, a standard work breakdown structure (WBS), network, and bill of materials (BOM) will be copied to produce a manufacturing plan. High-level capacity planning is then carried out on key work centers using the production planning (PP) functionality (which we'll discuss in Section 5.3), and any long lead procured items can be identified and the purchasing cycle can be initiated through the SAP S/4HANA materials management (MM) functionality (which we'll touch on in Section 5.4). The project systems functionality allows specific budgets to be assigned to the manufacturing plan so costs can be managed in real time as the production cycle is executed. Because the sales order is also associated with the manufacturing project, Bault Robotical can identify the profitability of each sale by comparing revenue and costs.

After the high-level planning is complete, and all required approvals are attained, the demand from the project is released to the production plants by using the MRP cockpit and the optimized material requirements planning (MRP) functionality in SAP S/4HANA. This will produce either a planned production order for all in-house produced parts and subassemblies or purchase requisitions for all externally procured parts. Dates for each order or requisition are dependent on where the BOM item is assigned in the project network, allowing planners to coordinate a large number of demands across multiple parts and subassemblies. Production controllers will then coordinate the scheduling of the production orders from each manufacturing project across the shared manufacturing works centers in PP to balance capacity and demand. The production controllers will also review available stock of raw materials, parts, and subassemblies required for each production order through PP reporting, before confirming that the order can be released to the shop floor.

Once released for production, all materials required for the operations on the production order will be issued from the stores via SAP S/4HANA supply chain functionality and SAP Extended Warehouse Management (SAP EWM) so they are available on the production line. Operators use an SAP Fiori shop floor app to view and execute the operations assigned to them on the order, confirming consumption of stock and

labor booking. After the item is completely manufactured, the order is closed, and the finished product is returned to the stock, ready to be used in the next level of assembly or manufacture. During the production process, operators are documenting quality inspection results via the SAP Fiori app, and where any defect is discovered, a quality notification is raised, and the items is sent for rectification or disposal.

Bault Robotical outsources the manufacture of a number of key components, such as printed circuit boards for the control systems. These are designed in-house but are assembled by a third party. The components are procured by Bault Robotical but then shipped to the third party for final assembly. In SAP S/4HANA, the subcontracting process is used to create a purchase order and deliveries (inbound and outbound) to allow the work in progress (WIP) item to be taken from the manufacturing plant, delivered to the supplier, and then returned to the plant after the operation is complete. This integrates functionality across the supply chain, and it gives Bault Robotical a full audit trail of all products that are processed off-site.

After all major subassemblies have been manufactured, the assembly of the final product is managed via the project network. This allows assembly planners to coordinate the final assembly as soon as the major assemblies start being completed. After the final assembly is complete, it will be returned to stock, ready for final delivery to the customer.

With the integration between SAP S/4HANA Sales and project systems (PS), the final price of the finished item can be calculated using the resource-related billing submodule within SAP S/4HANA to accommodate any changes in design or build during the production process. After the final costs and prices are agreed on, the finished product is delivered via SAP S/4HANA Sales and then billed. All revenue and costs can then be analyzed and reported through the PS, and profitability can be managed accordingly.

5.2 SAP Portfolio Overview

SAP provides a number of products that relate to the planning, execution, and quality control of manufacturing processes. In this section, we'll outline the portfolio and summarize each application to provide a reference for the rest of the chapter and to give sufficient background before going into the detail of how these solutions can be combined to support your manufacturing processes.

Figure 5.1 provides a high-level look at the three areas of manufacturing in SAP:

- **SAP Integrated Business Planning (SAP IBP)**
  SAP IBP is a cloud product that partially replaces SAP Advanced Planning and Optimization (SAP APO) along with functionalities now found in SAP S/4HANA. Although we cover SAP IBP in some detail as part of Chapter 3, it's worth mentioning its role in manufacturing of providing the demand forecasts required to adequately plan production, materials, and capacity.

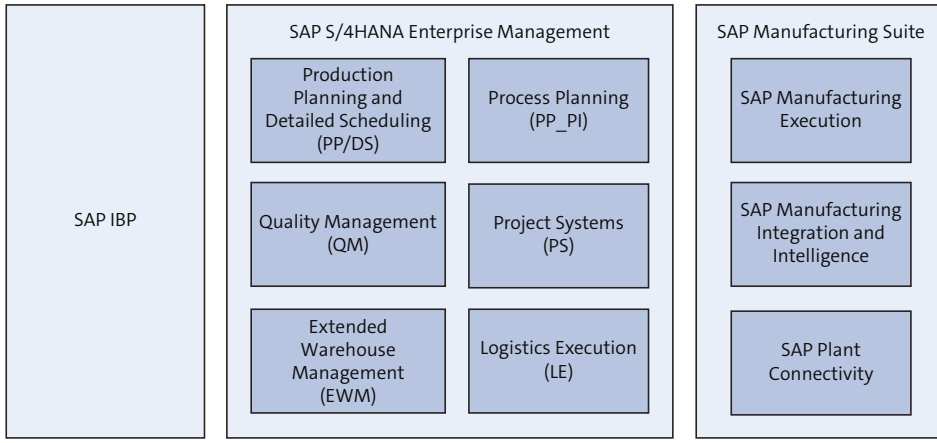

Figure 5.1 Overview of the SAP Portfolio Related to Manufacturing

- **SAP S/4HANA Enterprise Management**
  SAP S/4HANA Enterprise Management contains a number of functionalities that play key roles in manufacturing, from production planning and detailed scheduling (PP-DS) and process planning (PP-PI) that carry out detailed planning of manufacture through MRP types, create and manage planned orders and production orders, and integrating with other functionalities such as financial accounting (FI).

  Within industries such as aerospace and defense where large and complex items need to be planned, the PS functionality allows subassembly planning to take place that drives shop floor production and again links into related functionalities such as FI and MM. The QM functionality, on the other hand, focuses on the quality of the output from the manufacturing process, providing quality inspection plans and orders to manage checks and record results. Quality notifications are used to record and manage issues and defects.

After you have something to put in your warehouse, embedded EWM in SAP S/4HANA allows you to manage both semi-finished and finished goods with line-side stock management and warehouse management capabilities before the logistic execution (LE) functionality takes over to deliver the end product to the customer.

- **SAP Manufacturing Suite**
  To better integrate the physical manufacturing process with the planning and stock management, the SAP Manufacturing Suite provides three elements. First, the Manufacturing Execution System (MES) facilitated by SAP Manufacturing Execution enables the control and management of manufacturing and the shop floor through paperless execution of production orders and the ability to have complete visibility of components and materials.

  MES is then combined with SAP Manufacturing Integration and Intelligence, which supports the connection of equipment, people, and operations to tightly integrate the manufacturing process with business operations. SAP Manufacturing Integration and Intelligence also displays the integrated data from the enterprise and plant systems to measure and compare the performance of plants and assets.

  The last element of the SAP Manufacturing Suite is SAP Plant Connectivity, which connects the devices and equipment on the shop floor to the wider IT systems in your landscape, opening up the possibility of a truly connected manufacturing process from planning through to physical execution.

5.3 Production Planning

It's often said that planning is an art rather than a science; in reality, it's probably a bit of both by combining the powerful algorithms available within the various SAP applications covered in this chapter with the experience and knowledge of the planners themselves. Production planning can be boiled down to defining the what, when, and how many; that is, what are you going to make, when are you making it, and how many are you making?

Manufacturing, regardless of the type, begins with a demand, which is just another way of saying a requirement to make something. The demand comes from outside of manufacturing and is covered in more detail in Chapter 3.

The nature of this demand can take the following forms:

- **Push type**
  Manufacture is based on forecasts rather than actual demand.
- **Pull type**
  Manufacture is based on actual demand.

The fundamental job of manufacturing is to manufacture products in the most efficient way possible to satisfy this demand.

Production planning is a critical part of any manufacturing process and starts with forecasting the demand of a product and sales plan preparation. The sales plan is then synchronized with a production plan to take the production realities into account, such as capacity constraints (which we'll discuss in Section 5.4). Various simulated models are considered, and the finalized production plan becomes the basis of MRP. This process is commonly known as sales and operations planning (S&OP) and is supported within SAP S/4HANA using tools such as SAP IBP for sales and operations, as discussed in Chapter 3.

Now, let's take a look at the various planning strategies you can adopt and the MRP processes and SAP S/4HANA Enterprise Management functionalities that allow you to plan effectively.

5.3.1 Planning Strategies

Having discussed the type of production that a manufacturing organization may adopt, we'll now look at planning strategies, which are the interplay between sales and production. Production and sales strive for the same thing, that is, to have the correct product, in the correct quantities at the right time for a customer. However, running alongside this desire is also a need produce products in as efficient a way as possible while also ensuring that the optimal amount of stock is produced. Properly considering planning strategies helps to achieve this.

Figure 5.2 shows the following strategies:

- Make-to-stock (MTS)
- Make-to-order (MTO)
- Assemble-to-order (ATO)
- Engineer-to-order (ETO)

Let's take a closer look at each strategy.

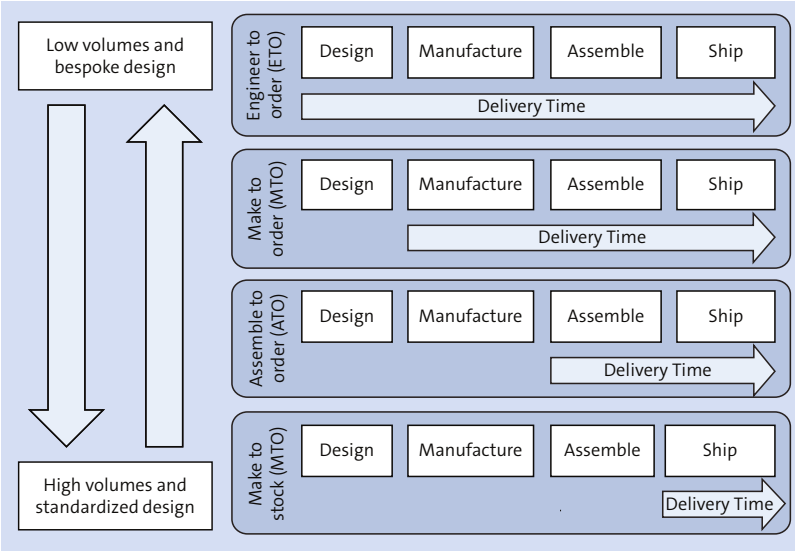

Figure 5.2 Manufacturing Planning Strategies

Make-to-Stock

When you go into a shop and buy a prepackaged ham and cheese sandwich, this is an example of an MTS strategy. In the simplest terms, the production of the sandwich happened before the requirement for the sandwich existed. The shop made the sandwich and "predicted" that someone would come in and buy it. This forecast was based on previous demand for ham and cheese sandwiches and set against the expectation that the customer would not accept the long delivery time associated with producing the sandwich after the request had been made.

Ultimately, a forecast is simply a best estimate of the forward customer demand based on a number of influencing factors, the most basic of which is historical demand. This means that rather than triggering and driving production, the sale order (when it arrives) consumes existing stock, ensuring the customer lead time is kept to a minimum. An MTS planning strategy allows organizations to maximize production efficiency through efficient production lot sizes, minimize down time and production changeovers (moving from one product to another), and increase the response to customer orders in a timely and agile manner. However, MTS does mean that an organization is producing stock before it knows it has a customer for it, which means that accurate forecasting becomes of paramount importance. Without it, the organization risks producing excess or insufficient stock leading to either wastage, as

in the case of excess stock, or potential reputational damage when existing stock doesn't suffice for a customer order.

Make-to-Order

Imagine you decide this time to purchase a sandwich from a café. Your order is written down and taken to a kitchen where your sandwich is made as a specific response to your request. Unlike under an MTS strategy, your customer order has effectively triggered production, and as a customer, you need to wait for the production to be executed. Depending on how busy the café is or whether someone has to nip out and buy more cheese, the actual delivery time will vary. In an MTO scenario, the product is allocated to you as a customer throughout its manufacturing cycle; generally, the order will carry a table number, name, or some other identifier (in SAP terms, a *special stock*) that signifies they've reserved your sandwich for you.

Using an MTO strategy has benefits and drawbacks; unlike MTS, manufacturing is done for a specific customer and is aligned directly to an immediate and identifiable sale. This minimizes the chances of holding excess stock of products that never lead to revenue. On the downside, however, a production line isn't able to take advantage of the optimization that can be made when operating an MTS model.

Many people reading this may also have heard about configure-to-order (CTO). Although some commentators expound certain differences between this strategy and MTO, for the purpose of this chapter, we'll group this strategy in with MTO. SAP S/4HANA supports CTO with the use of variant configuration.

Assemble-to-Order

ATO can be thought of as a hybrid of MTO and MTS strategies. In ATO environments, products are assembled from components only after the receipt of an order from a customer. However, unlike true MTO production, the key components in the assembly are procured or manufactured against a forecast rather than waiting for the customer order. Adoption of an ATO strategy is useful when a large number of products are based on common components and are assembled to meet the specific requirements of a customer.

In our sandwich scenario, ATO can be represented in a situation where the cheese and ham is already sliced, the bread is already buttered, and a side salad has already been chopped prior to any orders being received from customers. As soon as your order for a ham and cheese sandwich is received into the kitchen, these standard components are assembled to make your finished meal.

In a manufacturing environment, the ordering of a custom laptop is a good example of ATO. The key components, such as keyboard, screen, motherboard, and so on will be held in stock but assembled based on the specific customer order. For these kinds of industries, the suitable adoption of an ATO strategy helps to minimize the obsolescence risk that comes with MTS while also speeding up the delivery time to the customer compared to MTO.

Engineer-to-Order

Consider the scenario when you as the customer can define every aspect of the sandwich, from the ingredients and preparation of the bread to the type of filling. Everything is ordered, cooked, and prepared from scratch and only after the order for the sandwich has been received. This is an example of an ETO strategy. In reality, as can be seen by this example while you may well get a fantastic sandwich created to your unique specifications, many would be put off by the extremely long delivery time and also the cost because as everything is made specifically for the individual customer requirement, the costs associated with the manufacturer are significantly higher compared to other planning strategies.

In the real world, following an ETO approach often sees a constant dialogue between the customer and the manufacturing company as the manufacturing company is in effect helping customers to fully understand what the product they need actually looks like. As such, there is a need to effectively manage change, particularly in industries such as aerospace and defense where customers require detailed knowledge of the delivered product "as built" rather than "as designed"; for example, when you're building an aircraft carrier, no two are the same.

5.3.2 Material Requirements Planning in SAP S/4HANA

MRP helps the production and the procurement planners know when to procure and produce a material for its eventual availability and dispatch to the customer. The MRP run is the heartbeat of any manufacturing plant and will be managed by a team of dedicated MRP planners. SAP S/4HANA Enterprise Management offers a sophisticated MRP tool (MRP Live) that allows organizations to manage requirements into production and procurement across multiple plants to balance capacity and demand. Figure 5.3 shows the MRP Live selection screen.

All planning scenarios require MRP execution, as described in the previous chapter, and will use the material master to determine the planning type to be used. Once

identified, MRP will then take into account the necessary elements for that planning type when creating the material plan.

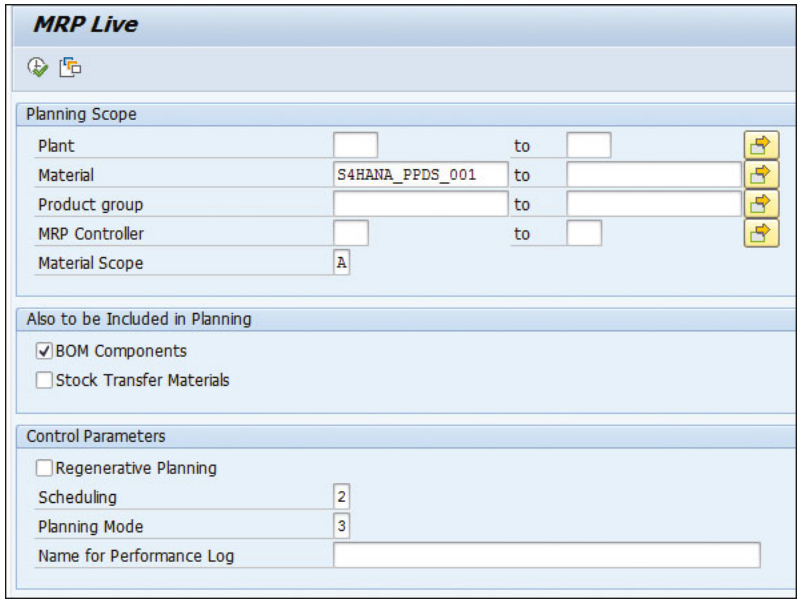

Figure 5.3 MRP Live Selection Screen

For the tool to be executed, a number of master data objects need to be maintained within SAP S/4HANA Enterprise Management:

- **Material master**
  This is the central repository of all data for a material in SAP.
- **Work centers**
  Master data elements represent real machines, such as production lines and assembly work centers.
- **Routings and master recipe**
  These serve as the blueprint for how and with what a material is made.
- **BOM**
  These are the other materials needed to make the item being manufactured.
- **Production version**
  If multiple BOMs and routings/recipes exist, the production version tells the system which combination to use.

After the MRP run has generated the production demand, capacity requirements planning (CRP) will be completed, which consists of the following processes:

- **Capacity evaluation**
  Reflects the load and overload for work centers and resources.
- **Capacity leveling**
  Helps the planner optimize the production processes. The PP-DS functionality can be used to complete sophisticated capacity leveling across complex and multi-plant manufacturing processes. Single plant capacity planning doesn't require the use of PP-DS. This is achieved using standard capacity planning with the PP.

An important part of the planning process is determining the cost of production to ensure that the item is sold at a profit. The product costing functionality in SAP S/4HANA Enterprise Management integrates with PP-DS and is responsible for ensuring all production-related costs are accounted for, including overheads, variances, and WIP.

What's Right for You?

PP also supports third-party production management processes and philosophies such as Lean and Kanban.

Lean originated from the Toyota Production System (TPS) and looks to minimize waste throughout the manufacturing process in terms of materials, resource, and time by focusing on activities that generate value and removing activities that don't. Kanban is a scheduling system for lean based on a pull system by using cards or signals known as Kanban cards. These cards control the flow of material into the production facility and work well for both in-house produced materials and outside procured materials. Kanban reduces waste by providing stock on a just in time (JIT) basis. As origins of Lean attest, Lean, Kanban, and JIT together with just in sequence (JIS) are commonly found in the manufacturing facilities of the automotive industry.

5.4 Production Execution

Production execution is the process whereby products are actually manufactured. Together with the generation of the finished (or semifinished) materials, this process may also generate scrap, co-products, and byproducts. In this section, we'll also cover constrained capacity scheduling, which allows the shop floor planners to ensure that the flow of product through the production process is seamless.

Because modern production environments consist of both manual and automated work execution, it's imperative that any production control system interacts with the machines and labor executing production operations so they can be continually monitored. SAP tools such as SAP Manufacturing Integration and Intelligence and MES allow collection of shop floor data from both individuals and machines, supporting processes such as operation completion and finite capacity scheduling.

Before a production order is released to the shop floor, production control will complete a level of material and resource scheduling by work center using PP-DS (detailed scheduling – finite scheduling) based upon the routing assigned to the production order.

The role of PP-DS within SAP S/4HANA is to achieve a similar conceptual output to that of either SAP IBP or SAP APO: a demand against which manufacturing is scheduled and carried out. PP also allows for the execution of production through the use of orders against which confirmations of time are entered, materials are staged and issued, and milestone operations are confirmed.

This tool includes constraints such as labor capability and machine capacity. User interfaces and tools, such as planning boards in PP and heuristics (capacity constraints into account), allow the control team to coordinate the flow or work through the manufacturing line.

Materials required to be used within the production process, including tools and consumables, will form part of the planned BOM assigned to the production order. This is integrated into MM to allow stock management to create any kits required prior to production execution. After the order is released, the parts and tools can be issued from stores and moved to the production line ready for use.

A number of activities within a manufacturing routing may be carried out by third parties, either within the plant or sent to the supplier for work to be carried out. Subcontract manufacturing (supplier collaboration management) in SAP S/4HANA allows both scenarios to be carried out easily. The external subcontract process includes integrations into MM and LE to support the movement of the part to and from the supplier and can include quality inspections upon receipt of the completed work.

5.5 Manufacturing Execution

In its most basic form, an MES (sometimes known as shop floor control systems or production control systems) is a central cockpit from which all factory floor activities can be monitored and controlled. While other solutions within this chapter are contained with the SAP S/4HANA Enterprise Management "core," it has never been designed to manage detailed production execution.

This is where an MES comes in by collecting real-time data from machines, material, and people within the production process and using this information to both manage and optimize execution.

Digital Disrupter

While MESs have been around for some time, they have become more important to organizations in recent years as the trend for outsourcing manufacturing to lower cost countries has become more prevalent. This globalization of manufacturing has forced major changes in manufacturing organizations that are now increasingly being forced to offer cost reductions and reduced lead times to stay competitive. MESs help in this endeavor by collecting the granular information needed to both prevent issues and provide insight into areas of improvement.

SAP Manufacturing Suite is a combination of SAP Manufacturing Execution with SAP Manufacturing Integration and Intelligence and SAP Plant Control. When combined with SAP S/4HANA, these products offer an integrated solution to manage and control manufacturing and production processes throughout the company. Production orders are made transparent and can therefore be optimized.

In the following sections, we'll explore each of these solutions.

Out with the Old

As previously outlined, MES doesn't sit within the natural scope of ERP systems, which have more traditionally focused on accounting requirements, material, and people logistics and planning from a manufacturing perspective. The 2008 acquisition of Visiprise, which led to SAP Manufacturing Execution, marked an achievement of a long-held desire from SAP to deliver an end-to-end solution for manufacturing customers. In subsequent years, MES has undergone changes and become more seamlessly integrated with the SAP core.

5.5.1 SAP Manufacturing Execution

In a simple sense, SAP Manufacturing Execution makes it easier to organize and control the production process. It provides a complete genealogy and traceability record throughout the product lifecycle, including creating an audit trail of all processes, components, and materials involved in the manufacturing and packaging of the product.

The key features available in SAP Manufacturing Execution are as follows:

- Integrates the shop floor with SAP S/4HANA in real time by synchronization of master data, shop floor control information, inventory management, quality information, and information relating to plant maintenance (PM). SAP Manufacturing Execution also works with MTS, MTO, and repetitive manufacturing production processes.
- Provides additional information to production routings defined in SAP S/4HANA with granular steps for shop floor execution.
- Better visibility of WIP together with more granular information around defect processing and noncompliance.
- Granular traceability of components during the manufacturing process.
- Working through SAP Manufacturing and Intelligence allows for the connection of SAP Manufacturing Execution to plant equipment, which provides Statistical Process Control (SPC). SPC is an industry-standard methodology for measuring and controlling quality during the manufacturing process.

5.5.2 SAP Manufacturing Integration and Intelligence

SAP Manufacturing Execution interfaces to SAP S/4HANA through SAP Manufacturing Integration and Intelligence. SAP Manufacturing Integration and Intelligence functions as a data hub and provides analytics and workflow tools for identifying problems in the production process and improving its performance. As the name implies, SAP Manufacturing Integration and Intelligence consists of two key components:

- **Integration**
  The integration component effectively provides a link to SAP from SAP S/4HANA, SAP ERP, and related business applications with plant floor applications in a consistent user experience. SAP Manufacturing Integration and Intelligence employs web technology to extract and consolidate data from multiple sources and makes it accessible from a variety of devices. SAP Manufacturing Integration and Intelligence also provides functions to control and enhance key master data, including

routings, work centers, and materials, together with transactional data, such as production orders, planned orders, and inventory information. SAP Manufacturing Integration and Intelligence together with SAP Plant Connectivity allows for SAP Manufacturing Execution to be integrated with shop floor automation control systems, such as Supervisory Control and Data Acquisition (SCADA), to garner real-time information for machines and processes.

- **Intelligence**
  The intelligence component provides for the on-demand analysis of the detailed manufacturing process using dashboards to monitor key performance indicators (KPIs) and alerts. This intelligence informs the manufacturing process and gives real-time information to operations team to make more informed production decisions. SAP Manufacturing Integration and Intelligence can also be used as the source of performance information allowing an organization to better focus its use of continuous improvement initiatives such as Six Sigma and Kaizen.

In Figure 5.4, you can see a representation of the hub role played by SAP Manufacturing Integration and Intelligence, linking the additional functionalities brought by SAP Manufacturing Execution with SAP S/4HANA.

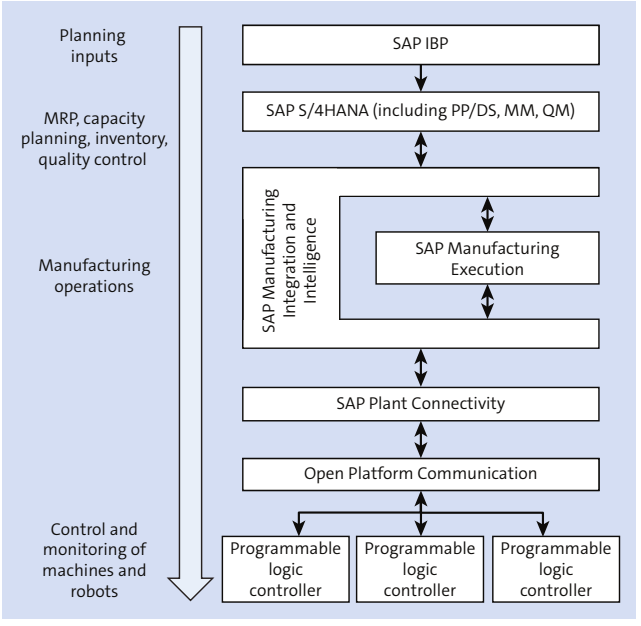

Figure 5.4 Outline of the Role of SAP Solutions in Taking Manufacturing from Planning to Physical Manufacture

It also shows how SAP Manufacturing Integration and Intelligence links production control systems that actually run the manufacturing processes to SAP S/4HANA (Section 5.5.3).

5.5.3 SAP Plant Connectivity

SAP Plant Connectivity is a Microsoft .NET developed software component of the SAP Manufacturing Suite that supports communication among control systems, control devices, files, Transmission Control Protocol (TCP) sockets, and other operational technology. This links the machines, robots, and data on the shop floor with SAP Manufacturing Suite and other SAP applications, such as SAP S/4HANA.

As shown earlier in Figure 5.4, SAP Plant Connectivity supports Open Platform Communication (OPC) technology that enables complex coordination tasks in the programmable logic controllers (PLCs) on the shop floor, for example, within highly automated and complex automotive engine assembly. Sensors on the shop floor can then be used to feed IoT applications, such as predictive maintenance for shop floor, for machines and robots. Data sourced through SAP Plant Connectivity can also be used in SAP Manufacturing Integration and Intelligence and SAP S/4HANA to measure overall equipment effectiveness (OEE).

5.6 Production Quality Management and Delivery

This section focuses on how to ensure that the manufacturing process is producing consistent and acceptable products. Embedding quality checks in the production process, can reduce customer returns and other rejections.

In SAP S/4HANA, it's possible to continually monitor the quality of the items being manufactured as they pass through each production operation. This is achieved through functionality in the QM functionality in SAP S/4HANA, which includes the following:

- **Quality inspection lots**
  Lots refer to the quantity of material to be inspected.
- **Quality inspection characteristics**
  Inspection characteristics define the types of inspections that need to be carried out by the operator at each production activity, and the results of the inspection can then be recorded in SAP.

- **Quality notifications**
  If there are any defective items, these can be documented and managed via quality notifications through to rectification or disposal.

The QM functionality in SAP S/4HANA enables a fully audited manufacturing process that meets international standards and is flexible enough to accommodate specific customer requirements.

As the manufactured item is moved between production operations, the operator or automated machine will record the completion of an operation against the production order in SAP. There are a number of manual and automated ways that the SAP production operation can be updated using standard SAP tools and interfaces:

- **PP functionality in SAP S/4HANA**
  Allows operators to record time and completion activities directly against the order through standard SAP Fiori apps that can be accessed on desktop and mobile devices within the plant.
- **SAP Manufacturing Execution**
  Enables operators to complete operations within a specific customer dashboard.
- **SAP Manufacturing Integration and Intelligence**
  Supports the machine's PLC interface to update SAP S/4HANA automatically if the operations have been completed by an automated machine. This information can then be viewed in real time through SAP Manufacturing Execution to coordinate the movement of the production items.

After the item has completed all the production operations, the production order is closed, and the item is moved into stock. If the item being produced is a subassembly to be used in the next stage of production, then it will be stored in the correct warehouse and stock type in MM. This new stock will be highlighted in the next MRP run, so that the production planners can then start the production of the higher lever assembly.

After all production processes are complete, the item will be stocked as a finished product and be ready for shipping to the customer. Any further quality checks can be carried out and recorded at this stage in SAP S/4HANA to ensure all customer compliance requirements are complete. Integration into SD and LE will allow dispatch to create the delivery documentation and issue the manufactured item to a customer sales order.

What's Right for You?

While we've gone through the manufacturing portfolio from SAP in this chapter, we don't have the space to dive into the industry-specific elements of the SAP portfolio. Fortunately, SAP has provided SAP Transformation Navigator tailored to specific industries, including aerospace and defense, automotive, chemicals, consumer products, and industrial machinery and components.

The SAP Transformation Navigator allows you to create your product map, start forming your business case, and plan your transformation journey based on your existing SAP solutions and the value drivers that are most relevant to your business.

The navigator isn't just limited to manufacturing industries; it also covers a variety of other industries, including higher education, professional services, public sector, and Insurance.

5.7 The Road Ahead

As you can see, there are a lot of products already within the manufacturing domain from SAP; however, the road ahead revolves around three main product sets:

- SAP Digital Manufacturing Cloud
- SAP Manufacturing Suite
- Manufacturing in SAP S/4HANA

Regardless of the product set, the overall aim is the same: to enable manufacturing to move toward being part of a fully integrated higher-level process from demand and design to production by taking onboard the ability to support mass customization of products, using machine learning and predictive analytics to improve planning outcomes, enabling processes to continually self-optimize, and creating 3D work instructions that are directly integrated to the original CAD drawings, among others.

We haven't yet discussed SAP Digital Manufacturing Cloud because it isn't yet fully formed. However, this is a really exciting development that brings the ability to control manufacturing execution alongside the ability to derive greater manufacturing insights and create a distributed manufacturing operation though the manufacturing network.

Developments in the SAP Manufacturing Suite and manufacturing in SAP S/4HANA (also described as SAP S/4HANA for production, engineering, and operations) are

aimed at eradicating the barriers between enterprise IT and the operational technology (OT) systems that run factories and shop floors around the world. For example, by integrating SAP Manufacturing Suite and SAP S/4HANA with the manufacturing insights capabilities in the SAP Digital Manufacturing Cloud, you could carry out cross-plant analytics globally, learn from the insights, and then provide optimized instructions back down to an individual machine level. Even linking with your manufacturing partners through the manufacturing network to optimize processes across your distributed operation is possible.

Having dealt with the manufacturing of products, our next chapter deals with the heavily interlinked topic of supply chain management, which provides both the raw materials for manufacturing and deals with storage and transportation of the finished products.

Chapter 6

Supply Chain Management with SAP S/4HANA

This chapter introduces supply chain management and specifically three SAP portfolio areas: SAP S/4HANA Enterprise Management, embedded extended warehouse management (EWM) in SAP S/4HANA, and embedded Transportation Management (TM) in SAP S/4HANA.

As we've already discussed in this book, numerous business processes exist to ensure that the optimal material is available at the right time, in the right quantity, at the right place, and of the right quality. These processes span sales, supply chain planning, sourcing and procurement, and manufacturing. The final part of this puzzle is supply chain management, which is essentially the glue that holds these pieces together.

To illustrate the point, let's explore SAP S/4HANA supply chain functionality through its interactions with these other lines of business, both within the core SAP S/4HANA Enterprise Management solution and beyond:

- **SAP S/4HANA supply chain and SAP Integrated Business Planning (SAP IBP)**
  As outlined in Figure 6.1, from an SAP product perspective, SAP IBP controls the forecast and mid- to long-term planning process and feeds into production planning and detailed scheduling (PP-DS; outlined in more detail in Chapter 5). As soon as this plan is executed, the processes within supply chain management come into play and either support manufacturing or the fulfillment of orders to the end customer.
- **SAP S/4HANA supply chain in the context of SAP S/4HANA sourcing and procurement**
  As soon as procured materials arrive (or even before) the supply chain processes within the SAP S/4HANA supply chain are initiated. Once arrived, the materials are checked to ensure that they are in line with the delivery paperwork and the expected purchase order (PO) quantity and quality. If any issues are found, the

supply chain process will look to return the stock to the vendor. Assuming that no fault is found, the goods will then either be putaway into a warehouse, cross-docked, or sent to a production line for immediate consumption.

- **SAP S/4HANA supply chain in the context of SAP S/4HANA manufacturing**
  To manufacture items, the correct components need to be picked, withdrawn from stock, and taken to the correct location at the correct time to be consumed as part of the manufacturing process. Failure to accomplish this in a timely manner means that the manufacturing process is interrupted and efficiency eroded. The same is true at the end of the production processes, where semifinished and finished goods are receipted and moved from the production line again either to a warehouse or for onward shipping to another site, distribution center, or customer. Supply chain processes also deal with any scrap, co-products, and byproducts that are created as a side effect to the manufacturing process.
- **SAP S/4HANA supply chain in the context of SAP S/4HANA Sales**
  At some point, the product will need to be removed from the location where it's being held and packed and prepared for shipment. In reality, many organizations don't simply hand over products to the customers at the gate. Depending on the procurement terms, organizations may need to plan and monitor the shipment of freight together with considering complex foreign transportation regulations, such as dangerous goods.

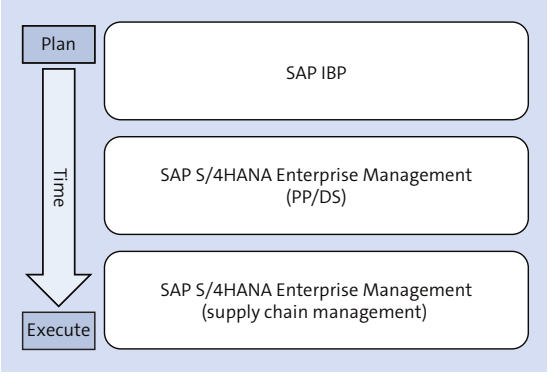

Figure 6.1 SAP Solutions as Plans Turn into Execution

In this chapter, we'll explore the main processes of supply chain management: inventory management, extended warehouse management (EWM), and transportation management (TM). For each process, we'll discuss the corresponding modern SAP portfolio. First, let's revisit our business case.

6.1 Business Case

Having already outlined how the supply chain is planned at Bault Robotical in Chapter 3, this chapter discusses how materials are physically handled, from the receipt of goods from a vendor through to the issue of stock onto a truck.

The choice among inventory management, basic warehouse management, or EWM is a warehouse-by-warehouse choice, rather than a single choice for the whole enterprise. Therefore, it's common for the same organization to manage small depots and stores using inventory management, medium-sized, and noncomplex warehouses using basic warehouse management, and large warehouses or distribution centers using EWM functionality.

In common with many organization of a similar size and complexity, Bault Robotical faced a similar challenge with some of its warehouses being managed at an inventory-managed level, some using SAP ERP Warehouse Management (SAP ERP WM), and some using SAP Extended Warehouse Management (SAP EWM).

As part of a recent acquisition, however, Bault Robotical had one facility that was causing significant issues. As can be seen in Figure 6.2, this facility was simply managed at an inventory level, meaning that it faced the following issues:

- Materials were held cumulatively at the storage location level, and there was no standard functionality to segregate materials into smaller storage sections such as bins.
- Due to all materials being held in a single storage location standard, inventory management stock counting and cycle counting functionality was proving to be not fit for purpose.
- To record which bins materials are held in, Bault Robotical had to adopt a nonoptimal process that involves the manual tagging of materials to bins.

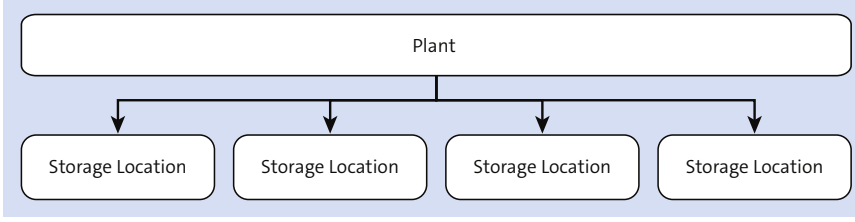

Figure 6.2 Bault Robotical Warehouse Structure Representation within SAP ERP

The main question that Bault Robotical faced was which solution to adopt to overcome these challenges. From a license perspective, Bault Robotical had two options: first, to try and solve these issues using functionality within SAP S/4HANA Enterprise Management (Section 6.2), or second, to implement EWM (Section 6.3). Ultimately, the choice between the two solutions came down to the size, complexity, and processing overhead of the warehouse.

At first, Bault Robotical believed that its decision was a straight choice between inventory management as part of the core SAP S/4HANA Enterprise Management solution and EWM. At that point, Bault Robotical had decided that because it needed picking and putaway functionality plus the ability to manage the warehouse based on a first in, first out (FIFO) strategy, the only choice was EWM. However, as soon as it became clear that SAP S/4HANA Enterprise Management contained basic warehouse functionality, including picking and putaway, Bault Robotical began an exercise to evaluate the two options. The choice wasn't a simple one, but Bault Robotical decided that due to the low complexity level of the warehouse and that it operated with a small team who didn't want to take on the perceived administrative burden of EWM, basic warehousing embedded in SAP S/4HANA Enterprise Management was the most suitable option.

6.2 Inventory Management and Basic Warehouse Management

As we've seen with Bault Robotical, inventory management and basic warehouse management is best used by small, noncomplex warehouses. This functionality is provided within SAP S/4HANA Enterprise Management and is the part of the digital core that provides the central functionality for the supply chain management capability.

Inventory management and basic warehouse management is concerned with the management and handling of inventory (stock). The SAP S/4HANA Enterprise Management functionality is designed to allow goods to be receipted, stored, issued, and transported in a controlled manner either internally with a warehouse or facility or between plants and storage locations. Furthermore, SAP S/4HANA Enterprise Management allows for stock to be valuated and tracked throughout the supply chain. This component also provides basic picking/putaway warehouse functionality.

In this section, we'll walk through the key inventory management processes and the relevant SAP S/4HANA Enterprise Management functionality.

6.2.1 Goods Receipt and Goods Issue

When goods that have been ordered from a vendor arrive at the site, they need to be receipted by the receiving organization. The receipt formally acknowledges that the goods requested through the purchasing process (e.g., via a PO) have arrived and signals the transition of ownership to the receipting organization (although the goods will often not have been paid for at this point). The receipted goods will be displayed in the receiving organization's inventory and forms a current tangible financial asset in the organization's balance sheet.

Outbound issuing is at the opposite end of the process to the inbound receipt process. This process relates to the removal of a material (and the corresponding financial asset) from inventory. This material will then generally be corralled into the correct shipment and packed ready for delivery to a customer. Finally, the material will be issued to the delivery, meaning that the inventory material disappears, and there is a corresponding posting into the cost of sales account. In common with much functionality within SAP S/4HANA, the goods issue can be done in a number of ways against a number of objects and through a number of transactions and applications. For those familiar with SAP ERP, Figure 6.3 shows that Transaction MIGO still exists for (among other things) general goods issues.

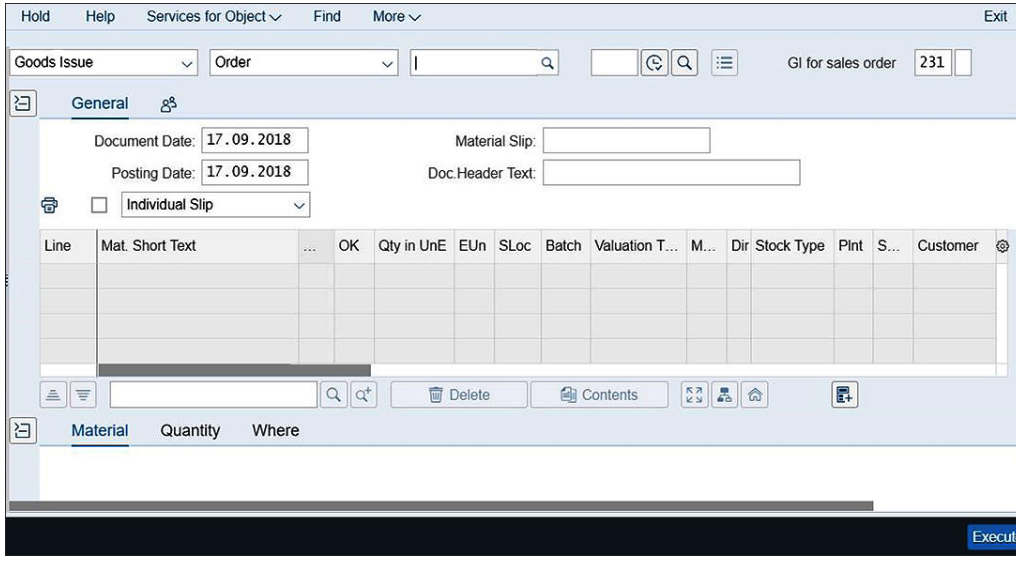

Figure 6.3 Goods Issue via Transaction MIGO Application in SAP S/4HANA

6.2.2 Moving Stock between Locations

SAP S/4HANA Enterprise Management also facilitates the movement of stock from one plant or storage location to another. This can either be via a simple one-step process (the stock is issued from one location, and instantly appears at another) or via a two-step process (the stock is issued and appears as stock in transit that is subsequently receipted into stock when it physically arrives in the receipting plant). SAP provides a new SAP Fiori app in this area to streamline the this process, as shown in Figure 6.4.

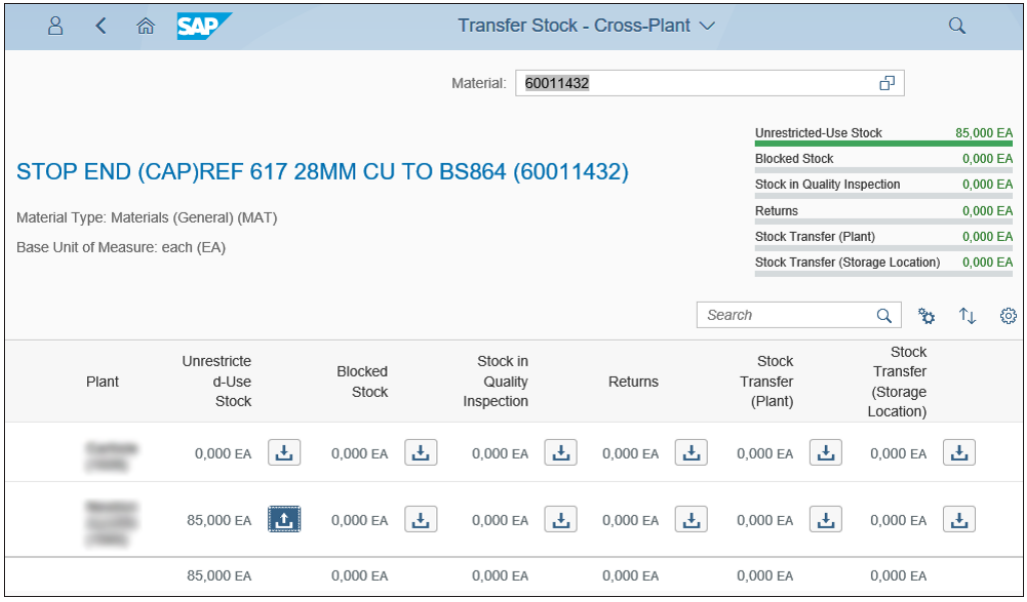

Figure 6.4 SAP Fiori App for Stock Transfer

6.2.3 Cycle Counting and Physical Inventory

SAP S/4HANA Enterprise Management contains a provision for physical inventory (stock takes) and cycle counting to be planned and executed at a storage location level. A stock check is a simple process whereby the stock in each location are physically counted and reconciled to the inventory situation within SAP. In a similar vein, cycle counting refers to the practice of counting a subset of inventory in a specific location and on a specific day. Cycle counts are less disruptive to daily operations than a stock take, which is often performed yearly and involves a shutdown, and provide a continual measure of stock accuracy and procedural execution.

Figure 6.5 shows how stock counting is managed in SAP S/4HANA Enterprise Management.

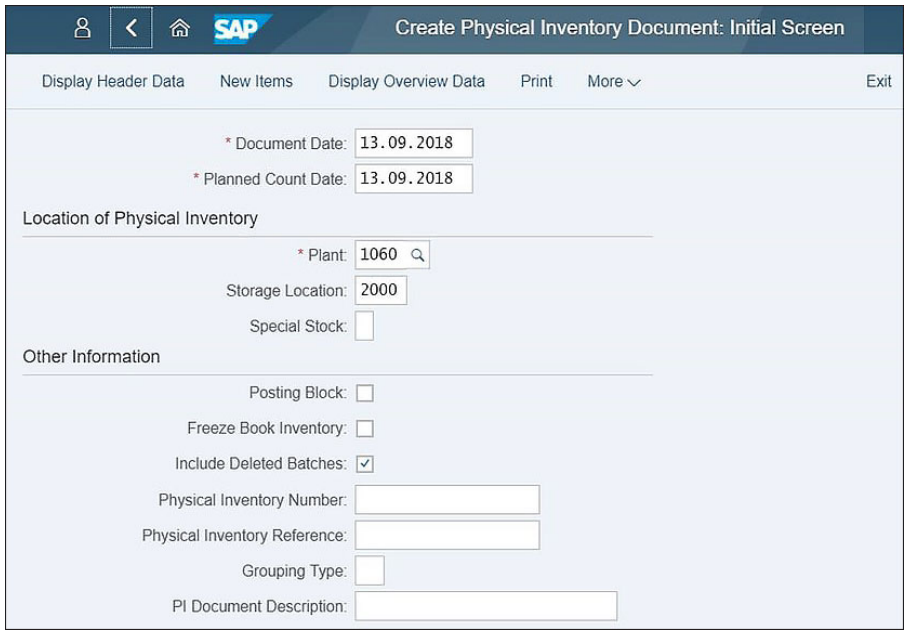

Figure 6.5 Stock-Taking Screen in SAP S/4HANA

6.2.4 Stock Types

Traditionally, SAP ERP (without SAP ERP WM or SAP EWM) only held stocks of materials at an inventory-managed level. In this section, we'll outline this topic in more detail and also demonstrate inventory management within SAP S/4HANA Enterprise Management. Because we've already discussed basic warehouse management within the case study, we'll contrast inventory management with the advanced warehouse management functionality available in embedded EWM in SAP S/4HANA.

As Figure 6.6 demonstrates, stock is held cumulatively in an inventory management location within SAP. This means that the total quantity of a material is shown together with the total value of the stock held in a specific storage location inventory management level.

Stock can also be segregated into different storage locations, as shown in Figure 6.7. This means that depots can be subdivided into multiple storage locations to represent physical areas.

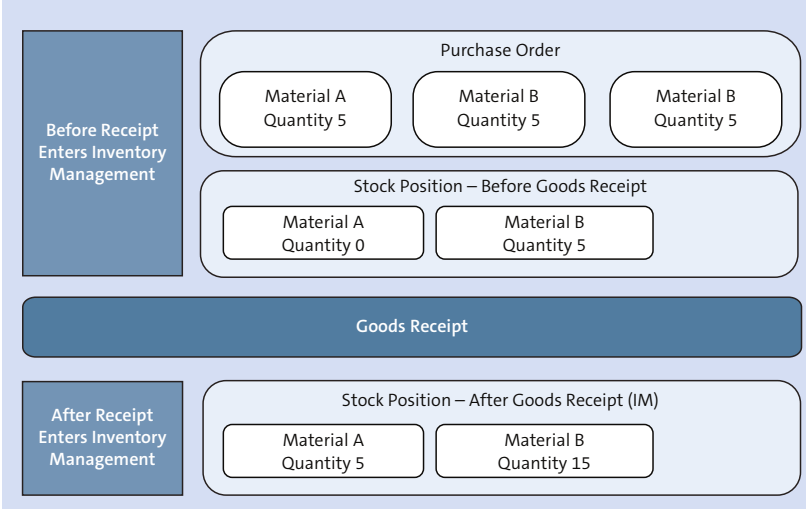
Before Receipt Enters Inventory Management
Purchase Order
Material A Quantity 5
Material B Quantity 5
Material B Quantity 5
Stock Position – Before Goods Receipt
Material A Quantity 0
Material B Quantity 5
Goods Receipt
After Receipt Enters Inventory Management
Stock Position – After Goods Receipt (IM)
Material A Quantity 5
Material B Quantity 15

Figure 6.6 Before View of Stock in Inventory

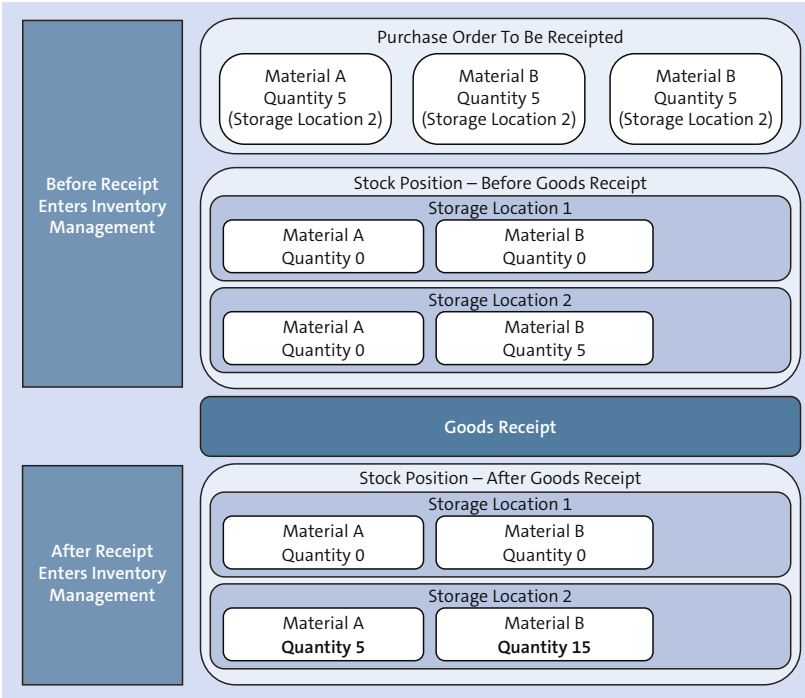
Before Receipt Enters Inventory Management
Purchase Order To Be Receipted
Material A Quantity 5 (Storage Location 2)
Material B Quantity 5 (Storage Location 2)
Material B Quantity 5 (Storage Location 2)
Stock Position – Before Goods Receipt
Storage Location 1
Material A Quantity 0
Material B Quantity 0
Storage Location 2
Material A Quantity 0
Material B Quantity 5
Goods Receipt
After Receipt Enters Inventory Management
Stock Position – After Goods Receipt
Storage Location 1
Material A Quantity 0
Material B Quantity 0
Storage Location 2
Material A Quantity 5
Material B Quantity 15

Figure 6.7 Multiple Storage Locations in Inventory Management

As stated previously, within SAP S/4HANA, inventory management stores materials cumulatively, as shown in Table 6.1.

Material	Quantity	Value
A	5	$10,000
B	5	$15,000
C	10	$20,000

Table 6.1 Example of Cumulative Stock within Inventory Management

However, there are occasions when organizations want to trace specific materials as in the case of batch management or serialization. Once again, this is entirely possible using standard SAP S/4HANA functionality, as you'll see in the following sections.

Batch Management

Generally, materials are produced in logical runs or batches, and in some industries, being able to identify the batch a specific material belongs to is not only critical but also a legal requirement. The rationale for this is that if a specific material has a defect or (as in the case of the pharmaceutical industry) a contamination, then you'll need to trace all other products produced as part of the same batch to check whether these items contain the same defect. To facilitate this traceability, inventory management maintains the integrity of the batch number and only cumulates materials of the same batch.

In Table 6.2, consider that Material C is batch managed.

Material	Batch	Quantity	Value
A		5	$10,000
B		5	$15,000
C	0000001	3	$6,000
C	0000002	3	$6,000
C	0000003	4	$8,000

Table 6.2 Stock Record with Batch Management

By using batch management (or at least using the functionality afforded by batch management), organizations are also able to track shelf life expiry dates (SLED) within standard SAP S/4HANA Enterprise Management. SLED is often used by organizations for which the age of a product is critical. For example, if a certain product has a shelf life of one year, then this information can be captured and reported using SAP S/4HANA.

Serialization

Serialization functionality in SAP S/4HANA Enterprise Management, in common with batch management, is designed to allow a greater degree of material granularity. However, whereas batch management groups together materials that were produced at the same time, a serial number is even more specific because it's generally used to link a single material to a single unique reference number (serial number). In practice, a serialized material is often stamped or labeled with the serial number, and the relationship between the product and the serial number often lasts for the entire life of the product.

In Table 6.3, consider that Material A has been defined as requiring a serial number assignment.

Material	Batch	Serial Number	Quantity	Value
A		MDR0010	1	$2,000
A		SDP01001	1	$2,000
A		BXK43212	1	$2,000
A		SXP22210	1	$2,000
A		YZP92341	1	$2,000
B	5		5	$15,000
C	0000001		3	$6,000
C	0000002		3	$6,000
C	0000003		4	$8,000

Table 6.3 Stock Record with Serialization Information Recorded

Special Stock

Up to now, we've considered all stock to be the same, but, in reality, some stock is special because, like batch management and serialization, the stock has a specific attribute that needs to be recorded in inventory management and that generally affects the handling and disposal of the stock. Following are a few examples:

- **Consignment stock**
  Although recorded in your inventory, this stock is in fact owned by a third party. While this makes little difference to how the materials are physically handled from an inventory valuation perspective, it's imperative that this stock doesn't contribute to the sum total of the organization's stock.
- **Subcontract stock**
  This is stock that will be provided to a vendor for the vendor to consume in the creation of a finished (or semifinished) material that is subsequently sold back to the organization.
- **Sales order stock and project stock**
  This is stock that has been made or procured specifically for consumption against a specific sales order or project. (You can't directly issue these to any other cost object.)

Other types of special stock exist and are represented within inventory management using a special stock indicator.

SAP S/4HANA Enterprise Management also contains the facility to block stock and place stock into a quality-restricted area. An organization may want to use this functionality to either segregate stock that is substandard (and hide it from MRP) or quarantine the stock until it can be inspected and released.

6.3 Extended Warehouse Management

EWM is the go-to process for organizations with warehouses/distribution centers that are too large/complex to be served by inventory management or basic warehouse management. Effective warehouse management is a complex discipline in its own right, however, for the purposes of this section, we'll simply say that EWM will likely be needed if basic warehouse processing such as picking, packing, and putaway fail to deliver the requisite warehouse processes and control needed by the organization. Specifically, EWM supports the following complex warehouse processes:

- Guided multistep picking and putaway
- Packing
- Confirmation of movements (together with blind checks)
- Stock determination
- Inventory management optimization (through activities such as warehouse slotting)
- Inbound process optimization (e.g., deconsolidation)
- Material flow control
- Yard management
- Dock appointment scheduling
- Kitting
- Cross docking
- Warehouse billing

Out with the Old

For many years, SAP has provided organizations with two solutions for warehouse management functionality: SAP ERP WM and SAP EWM. Both of these solutions provided additional functionality to allow organizations to better control warehouse processes and warehouse movements. SAP ERP WM has deep roots having been available in one form or another since the days of R/2 while the first version of SAP EWM was released in 2006.

In the new world, SAP ERP WM has been removed entirely (although it will be available until 2025 for current customers), and some of its functionality has been added into the core; however, SAP EWM has been extended and is now embedded in SAP S/4HANA 1610 in SAP HANA and is available under a separate license.

Figure 6.8 shows the SAP Fiori dashboard for embedded EWM in SAP S/4HANA.

Together with supporting the warehouse processes outlined earlier, embedded EWM in SAP S/4HANA also provides the following key functionality to ensure an optimized warehouse or stores:

- **Radio frequency (RF) functionality**
  Radio frequency framework (RF framework) and RF framework with resource management are integral parts of embedded EWM and decouple business logic from the physical presentation of application data on a selected presentation

device. Mobile data entry or scanning devices are supported for all processes. Goods are scanned through wireless mobile devices (known as RF guns) during warehouse operations in real time, and data is displayed (or entered) from (or to) the system. Mobile data entry provides several advantages, including paperless instructions, fewer errors, and increased efficiency. Embedded EWM also supports radio frequency identification (RFID) tags with SAP's Auto-ID Infrastructure.

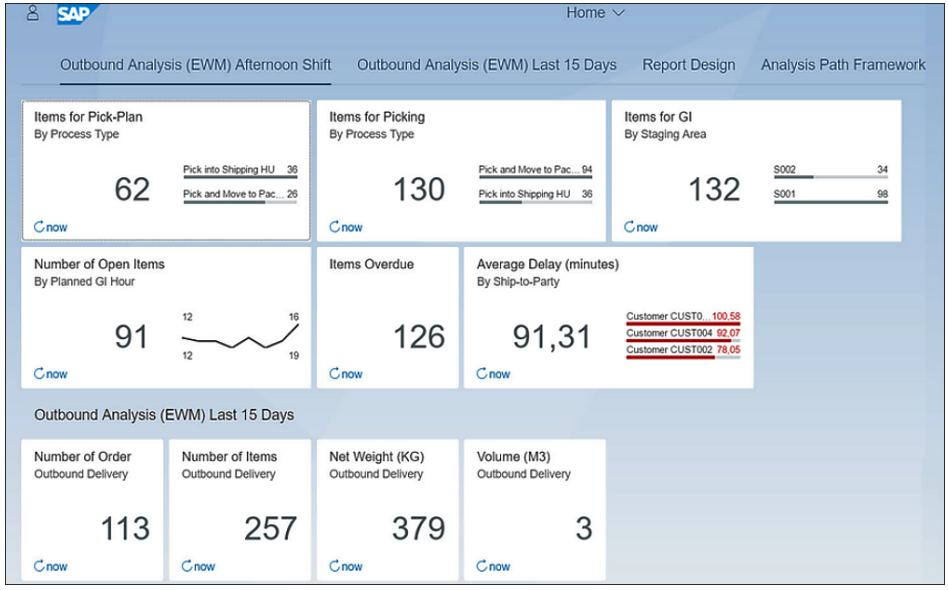

Figure 6.8 SAP Fiori Dashboard: EWM

- **Management of people and equipment as resources**

  Warehouse workers and equipment (forklifts) are considered resources in embedded EWM. Work orders are assigned to resources through queues either automatically by the system or manually by warehouse supervisors. Resources are created as master data and need to log on to RF devices to execute their assigned tasks. Within the system, you can define different queues for different processes, such as inbound, internal, and outbound movements. Work is assigned to one of these queues, which are, in turn, assigned to a resource.

  Embedded EWM can be set up to avoid overloading or congesting equipment (for example, forklifts) in a particular area. While assigning a resource to a new work order, the system checks whether there are other resources already working in

that area, then it skips that work order, and takes the next work order in priority with the less crowded area.

- **Labor management**
  Labor management in embedded EWM is a tool used to measure and improve the productivity of laborers/resources. Embedded EWM can perform labor planning and simulation, workload monitoring, and labor analytics and reporting.

6.4 Transportation Management

When it's time to move your goods out of the warehouse, TM comes into play. TM allows for the optimization of freight, which means goods transported in bulk by road, rail, ship, or air. This discipline encompasses all freight-based activities from tendering, through execution, and to payment.

Today embedded TM in SAP S/4HANA contains extensive functionality built around four core business processes.

Out with the Old

Like EWM, TM can trace its lineage back to legacy SAP, with its first release as a standalone product in 2009. In practice, the first TM type capability was included within the Logistics Execution (LE) module of R/3; however, this didn't contain any functionality to allow a business to plan logistics activities.

As of SAP S/4HANA release 1709, TM is now fully embedded into SAP S/4HANA. Embedded TM in SAP S/4HANA is based on SAP TM 9.5 and offers TM functionality without the need for interfaces, which reduces the possibility of data duplication between the systems as well as using SAP Fiori user access and SAP S/4HANA analytics functions.

Embedded TM in SAP S/4HANA is designed to complement the existing logistics and shipping functionality available since SAP S/4HANA release 1511. This functionality allows you to plan and schedule the delivery of goods, consider the optimum route and carrier, and calculate the associated transportation costs.

Figure 6.9 shows a dashboard for embedded TM in SAP S/4HANA.

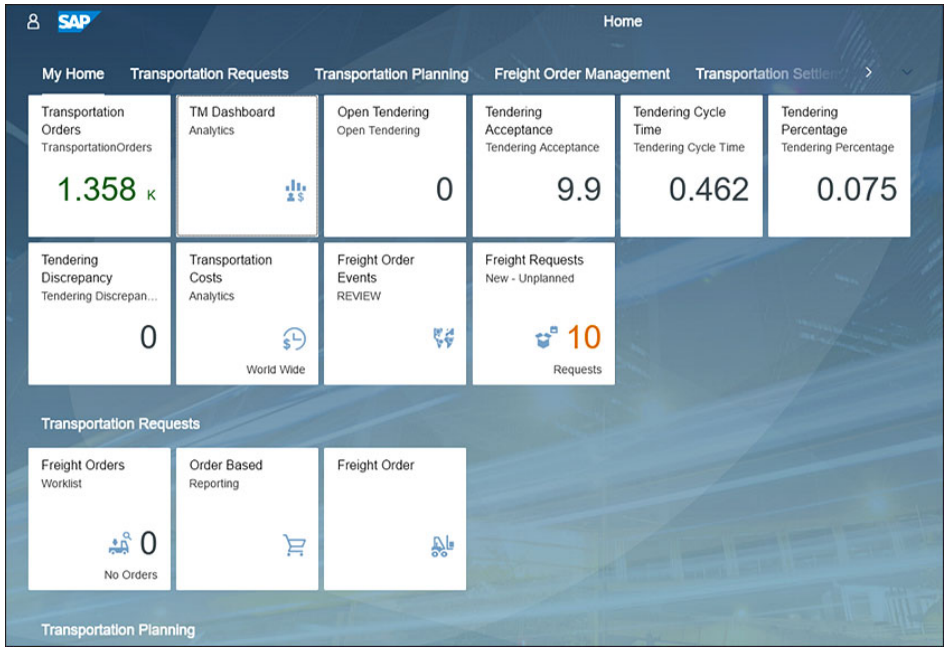

Figure 6.9 Embedded TM in SAP S/4HANA Dashboard

Embedded TM in SAP S/4HANA includes many key features:

- Creating freight units
- Planning and optimizing freight delivery
- Consolidating deliveries (inbound and outbound) into freight orders (FOs) or bookings
- Planning air and ocean shipment of freight
- Selecting carriers based on optimum shipment criteria
- Performing tender transportation services
- Monitoring transportation from the moment of dispatch
- Calculating transportation charges and settling costs of freight
- Considering foreign transportation regulations, such as dangerous goods

Let's take a look at how the key SAP TM business processes are supported in embedded TM in SAP S/4HANA:

- **Order management**
  Order management refers to the out-of-the-box integration to SAP S/4HANA processes, including order to cash and procure-to-pay, SAP ERP billing, and invoicing. Order management also covers freight orders (FOs), forwarding orders, and freight booking (FB) coving air, sea, and land transportation.
- **Freight management and tendering**
  Each freight unit combines all the goods requiring transportation across the supply chain. Freight unit functionality combines or splits quantities of goods into the required unit required for transport. Specific master data drives the creation of freight units based on route and transportation criteria.

  A FO determines the route, carriers, costs, and relevant paperwork required for the shipment of goods, whereas FBs allow for booking of space on a plane or ship.

  Freight tendering links the request for quotation (RFQ) process into the procurement of transportation. RFQs can be sent to any number of carriers, who then respond with the cost of those services with a freight quotation (FQ). Post award, a FO is sent to the carrier for the execution of services. FOs can be sent to each carrier without the need for a formal RFQ process. Carriers can reject or accept each FO within the costs and timeframe indicated on the FO.
- **Freight execution and monitoring**
  The process covers the actual execution of the freight process, which involves checking that FOs are ready for execution, any customs declarations are complete, and all relevant documents are printed. This execution process can be integrated with other systems, such as a customs management system or a warehouse system (e.g., SAP EWM).
- **Freight settlement**
  Freight settlement avoids complex payment processes by creating a freight settlement document based on any number of FOs and FBs for each carrier. Subject to invoice matching (invoicing matches the FO and FB), each carrier invoice is released for payment.

Embedded TM for SAP S/4HANA is also designed to integrate with other extended solutions within SAP S/4HANA, including SAP EWM, SAP Event Management, and SAP Global Trade Services (SAP GTS). This means that SAP has a fully integrated solution that provides a formidable set of capabilities for supply chain management regardless of how complex the supply chain.

6.5 The Road Ahead

Much of the functionality outlined within the supply chain management function isn't new to SAP S/4HANA but is rather an evolution of the functionality prevalent within SAP ERP. As a process, the supply chain management functionality within SAP, such as SAP TM and SAP EWM, reflects an embedding of functionality into the central core from which development of new capabilities will develop.

However, together with this centralization and development of legacy applications, SAP is, as outlined in other chapters of this book, also introducing Internet of Things (IoT) applications in certain key areas. Unlike the previous functionality outlined in this book, this is a fundamentally new solution from SAP based on the marriage of new technology and existing business pain points.

In regards to supply chain management, two of these IoT applications are as follows:

- **SAP Connected Goods**
  SAP Connected Goods is designed to facilitate a direct connection to customer-facing devices, such as drink dispensers, vending machines, and coffee machines, with backend systems (such as SAP S/4HANA). Alternatively, it also enables vendor-managed product inventory replenishment (VMI).

  SAP Connected Goods makes it easy to remotely capture and analyze sensor data from connected devices, enabling the automatic creation of replenishment orders based on actual consumption without the need for manual checking.

  The application also provides actionable insight into product usage patterns, service, and quality that both aids the S&OP process and also provides valuable information for the demand-sensing capability within SAP IBP and in evaluating the effectiveness of marketing campaigns.
- **SAP Vehicle Insights**
  SAP Vehicle Insight allows for the live monitoring of vehicle conditions. This application (shown in Figure 6.10) can help to ensure that efficiency is maintained internally within the supply chain by stopping business-critical breakdowns that affect goods in, goods out, and internal processing by forklift trucks and pickers.

  SAP Vehicle Insights also provides solutions for the optimization of vehicles that are external to a factory or storage facility by tracking vehicle position, routes, and conditions in real time, which can be used to predict, and thus mitigate, the impact of late deliveries by monitoring the behavior of the driver.

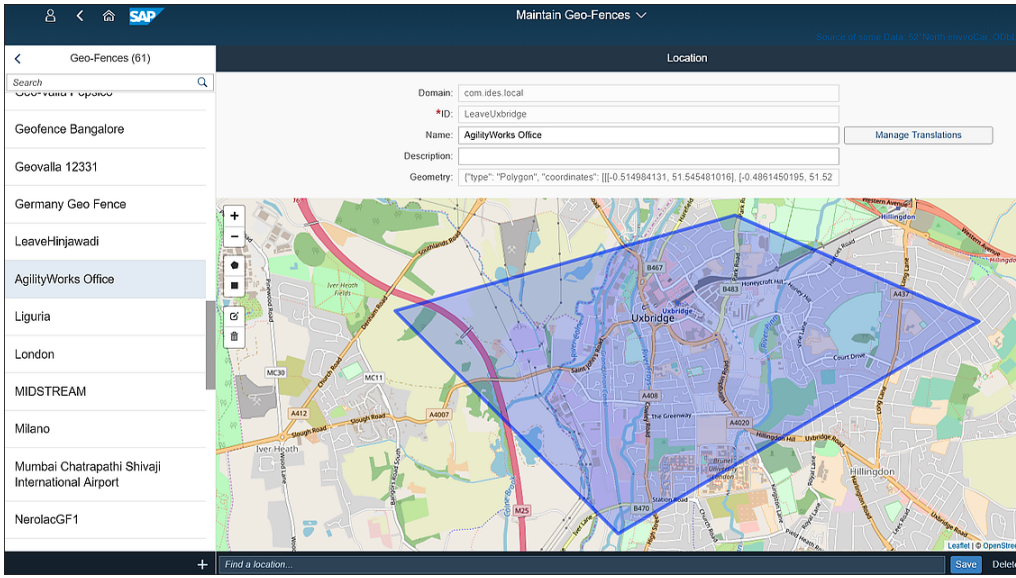

Figure 6.10 SAP Vehicle Insights

> Together with the benefits apparent within the supply chain, SAP Vehicle Insights can also provide a valuable insight for asset maintenance activities, which seek to predict asset failure before breakdowns occur.

In line with the other IoT applications from SAP, these are still relatively new and have had little mass adoption as of yet. However, by combining the latest technology, such as IoT machine learning, SAP is clearly looking for ways to both create new solutions to existing business challenges and enable new business capabilities and models.

In the next chapter, we'll dive into the maintenance of assets with asset management.

Chapter 7

Asset Management with SAP S/4HANA

This chapter introduces asset management and why it's important, as well as discusses how the key SAP portfolio items form a complete solution for the needs of an organization both now and in the future.

Manufacturing companies make "things" that they sell—hopefully at a profit. However, unless the organization maintains the machinery and equipment needed to make these things, then the company can't sell them, which is obviously bad business. This is where asset management comes in.

Asset management refers to the process of managing the machinery, equipment, and other infrastructure required for the smooth running of a modern business. Fundamentally, it's the process of ensuring that the tools used to make products or provide services are either fixed quickly when broken or maintained in advance to prevent them from breaking.

As machines have become more specialized and as organizations' reliance on them has become more absolute, the need for effective management of these assets has grown. In today's modern business, this need has developed to the point where now the profits of huge corporations are intrinsically linked to their ability to keep their assets operational. For example, a plane that is unable to fly or an oil rig that is unable to extract oil will cost its operators huge amounts in terms of lost revenue and incurred costs. However, a plane that crashes or an oil rig that explodes not only has these obvious financial consequences but may also cause injury and potential loss of life that can trigger huge reputational damage from which a company may never recover.

With these sums at stake, businesses must now give due consideration and thought to asset management, however, the current commercial reality means that this doesn't equate to a blank check for maintenance departments. Today, assets are managed with fine margins, meaning that organizations must push their assets as far as

they (safely and legally) can while ensuring that they aren't allowed to fail. Indeed striking a balance between performance and reliability is a key differentiator in many asset-intensive industries and is often a critical factor in dictating which companies succeed and which don't.

After taking a look at our business case's asset management landscape, we'll discuss the maintenance strategies used by companies and explore maintenance management and asset operations, and how each process is supported by SAP solutions.

7.1 Business Case

Like many manufacturing organizations, the suite of shop floor machines at Bault Robotical range from brand new and innovative to aging and "dumb." At the lower end of this spectrum sit many machines that perform noncritical operations. For many years, Bault Robotical chronically underinvested in its internal maintenance operations, meaning that at the beginning of the transformation, much of the activity that was performed in this area was reactive, that is, equipment was repaired after a fault had developed or the machine had broken down. However, as the frequency of these breakdowns increased, along with the potential reputational and revenue damage of each breakdown, it was decided to investigate and assess which assets would benefit from a more proactive preventative maintenance model. After much work, several types of machine were identified where the risks associated with breakdown, on balance, warranted a proactive rather than reactive approach to maintenance. As part of the transformation program, it was decided that the asset management functionality afforded within the core SAP S/4HANA Enterprise Management application would provide the requisite functionality and best practice approach needed to facilitate such as switch. Specifically, it was decided that time-based and performance-based planned maintenance should be rolled out to ensure that maintenance was based on machine usage rather than simply waiting for the specific machine to fail.

At the same time, Bault Robotical decided that for certain other assets, the predictive maintenance model would be evaluated to further optimize the maintenance processes and further reduce costs. This decision was made for two key reasons: First, while some machines were dumb, many others (particularly many of the newer machines) were "connected" and capable of providing a large body of information from which their "health" could potentially be derived. Second, SAP had recently launched SAP Predictive Maintenance and Service as its next-generation asset management solution that combines Internet of Things (IoT) and SAP Edge Services

technology with machine learning to enable maintenance based on the likelihood of the failure of a specific machine rather than simply based on the number of hours or days it had been used. It was felt that this combination could facilitate (for certain types of assets) a move to a predictive maintenance model.

As well as investigating SAP Predictive Maintenance and Service, Bault Robotical also looked at the other members of the SAP Connected Assets family (discussed in Section 7.3) and specifically used the SAP Asset Intelligence Network with SAP Predictive Maintenance and Service to create a fully integrated maintenance platform with its customers. This allowed Bault Robotical to monitor the condition of its own robots and provide a platform by which customers could log manual maintenance requests and make recommendations for improvements. These requests integrated with Bault Robotical's service processing function and were actioned as work orders.

The following sections discuss these two models in more detail and outline some of the key functionality enabled by both SAP S/4HANA Asset Management and SAP Connected Assets.

7.2 Maintenance Management

As has been outlined at the beginning of this chapter, keeping assets in good repair can have huge benefits to an organization. However, maintaining an asset often means bringing it offline and servicing or replacing elements, which incurs costs in the form of maintenance and potential revenue loss in the form lost utilization. Therefore, choosing when and how often to maintain assets is critical to ensure that the correct balance between maintenance and utilization is struck. In reality, this choice comes down to deciding which type of maintenance strategy to apply.

In the following sections, we'll investigate these strategies and take a look at the SAP portfolio that supports them.

7.2.1 Maintenance Strategies

Traditionally, organizations have operated either reactive maintenance (fix an asset after malfunction) or preventative maintenance (maintain on a predefined schedule). However, organizations are beginning to consider and adopt predictive maintenance strategies (e.g., using sensors to monitor the condition of equipment to predict malfunctions) particularly for high-value assets and assets seen as critical to the organizations operations.

Digital Disrupter

One of the factors that is changing the balance of the equation in favor of a predictive maintenance strategy is the emergency of the IoT and the associated decrease in cost of the infrastructure to support it. The cost of IoT sensors have fallen significantly over the past two decades with the average cost of sensors expected to be about $1.30 by 2020. As these cost continue to decrease, the business case for an asset management strategy based on prediction becomes stronger.

Figure 7.1 shows the three most widely adopted maintenance strategies, the advantages and disadvantages of each, and when each strategy is best applied. It also outlines which SAP product best matches the functionality required for each strategy.

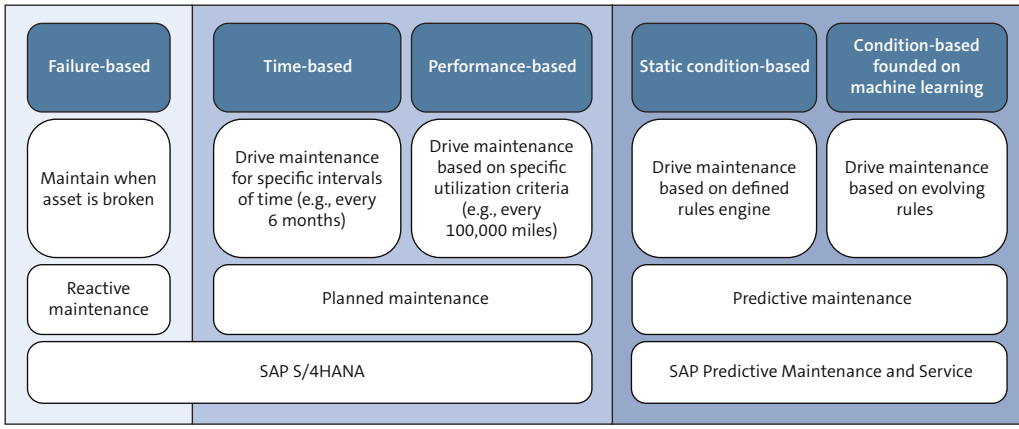
Failure-based
Time-based
Performance-based
Static condition-based
Condition-based founded on machine learning
Maintain when asset is broken
Drive maintenance for specific intervals of time (e.g., every 6 months)
Drive maintenance based on specific utilization criteria (e.g., every 100,000 miles)
Drive maintenance based on defined rules engine
Drive maintenance based on evolving rules
Reactive maintenance
Planned maintenance
Predictive maintenance
SAP S/4HANA
SAP Predictive Maintenance and Service

Figure 7.1 Key Maintenance Strategies

Let's take a closer look at the maintenance strategies shown in Figure 7.1, as follows:

- **Reactive maintenance**
  Reactive maintenance is also known as "breakdown maintenance" and refers to repairs that are done after an asset has malfunctioned. While this type of maintenance, generally speaking, takes less time and money than other types of maintenance (there is no initial cost associated with the prediction of failure), relying on this approach exclusively is somewhat shortsighted in the longer term, as some of the following points illustrate:
  - More expensive in the longer term: Unplanned downtime during production runs can lead to lower yield and customer orders being delivered late. Together

with resulting reputational and revenue damage, the unpredictable nature of reactive maintenance means that organizations may end up paying a premium for emergency parts shipping, travel time, and after-hours support.

- Safety issues: Relying on reactive maintenance for airplane and oilrig maintenance isn't a sound strategy! Furthermore, technicians tend to take more risks when maintenance work is reactive because they are under pressure to get the malfunction remedied and the faulty asset operational again.
- Asset life expectancy: Fixing an asset after it has malfunctioned isn't the same as keeping it in optimal working condition. Assets that are patched up tend to fail again and as a result deteriorate faster over time.
- Higher energy costs: When equipment isn't proactively maintained, it uses more energy. Even doing simple preventative maintenance activities, such as greasing moving parts or changing filters, can reduce energy consumption.
- Inefficient use of time and resources: While planned maintenance can be included in a production schedule, reactive maintenance often requires technicians to run around looking for manuals and schematics, ordering the right parts and trying to diagnose and fix issues.

- **Preventative maintenance**

  Preventative maintenance refers to the proactive, regular maintenance that is performed on an asset to lessen the likelihood of it failing. Preventative maintenance is planned and scheduled so that requisite technicians, parts, and schematics are available.

  For the purpose of this chapter, we'll discuss two types of preventative maintenance:

  - Time-based preventative maintenance: This is based on a simple schedule; that is, the asset is serviced once a year, every six months, or twice a week to ensure that maintenance activities are conducted regularly and by extension that the asset in question is kept in an optimal condition. However, it's also simplistic in nature and therefore runs the risk of over maintenance if the assets have been used less than expected or conversely risks malfunction if the usage of the equipment has been heavier than expected.

    To illustrate this point, imagine that you purchase a car. Although the operating manual recommends getting the car serviced every year, your first inspection ends in a squeaky-clean bill of health. This is an example of "over maintenance" because the car didn't need maintaining. Next, let's imagine within the first year that the car is driven for thousands of miles and breaks down on month 11.

These problems show the risks associated with heavy reliance on a simple schedule.

- Performance-based preventative maintenance: Maintenance activities are carried out when certain critical readings meet a certain predefined criteria. Turning once again to the car analogy, imagine the service is recommended after 10,000 miles. In this case, even though you've owned the car for one year, you've only actually driven 5,000 miles and therefore based on the relevant meter (in this case, the odometer), maintenance isn't yet required. As a result of this, the cost of unnecessary maintenance is avoided. Conversely, if you had driven 10,000 miles in six months, the service would be accelerated and the potential malfunction avoided.

- **Predictive maintenance**

  Although, in principle, the idea of regular planned maintenance as a means of reducing malfunction is logical, many believe that this isn't actually born out in practice. In fact, it has been estimated that only around 10% of complex assets fail predictably over time, meaning that far more fail randomly over time.

  The aim of predictive maintenance is to actively predict when equipment will fail with the aim of scheduling maintenance activities prior to that failure. This allows for the frequency of maintenance to be as low as required to prevent failure but without incurring the associated costs of preventative maintenance.

  Common techniques within predicative maintenance include vibration analysis, oil analysis, equipment observation, and thermal imaging. Regardless of the technique adopted, each involves the gathering of large quantities of data, such as maintenance records and data from sensors on the asset, analyzing the data, and creating a predictive model that determines the optimal time for maintenance tasks to be performed.

  Turning back to the car analogy, a very basic example of predictive maintenance is the interplay between a car's Engine Management System (EMS) and the driver. In effect, the EMS is monitoring various preset conditions within the engine, and when one is triggered, a signal is sent to the driver normally through the form of a illuminated icon on the dashboard. The driver is then provided with a warning that it's time to have the engine maintained. While this type of maintenance obviously has its advantages, to be effective, the assets in question must be subject to regular inspections or must be connected to a system that constantly monitors the status and conditions of the asset.

Digital Disrupter

It may be old news now, but one of the key digital disrupters in asset management that is still worth mentioning today is Supervisory Control and Data Acquisition (SCADA), which is a type of application that performs "process control" for predictive maintenance. In effect, SCADA gathers data in real time from remote locations with the intention of controlling assets and conditions. SCADA systems are used in a myriad of organizations, such as power plants, power grids, oil and gas refining, telecommunications, and many more. These systems can also monitor conditions and warn when conditions are becoming hazardous by sounding alarms or by automatically creating maintenance orders in integrated asset maintenance systems.

The cost of predictive maintenance has been traditionally high and, in many asset classes, prohibitively so, due to the costs of condition monitoring equipment and the costs associated with people who have the relevant skill level and experience to accurately interpret condition monitoring data. Therefore, organizations have had to decide whether on balance the costs associated with running a predictive maintenance program for certain assets is actually higher that simply allowing an asset to fail or to adopt preventative maintenance.

7.2.2 SAP Portfolio for Asset Management

The asset management functionality in SAP S/4HANA can be thought of as the logical successor to the Plant Maintenance (PM) module in SAP ERP. We won't focus on the differences within this chapter rather than attempt to provide a general overview of the functionality and the key maintenance activities that it facilitates.

We'll begin by discussing some of key elements with SAP S/4HANA Asset Management:

- **Functional location**
  A functional location generally represents complex multifaceted "things," such as a plant, building, or production line.
- **Equipment**
  Equipment generally refers to discrete equipment that (when static in nature) are normally installed within a functional location. For example, an individual industrial machine installed within a production line.

- **Assembly**
  An assembly provides a piece of equipment (or indeed a functional location) with a more granular structure. For example, a machine may be composed of various assemblies, such as power source, drive, and motion control. An assembly may be used when specifying the location of any damage and can be highlighted within an order.
- **Material**
  A material may represent a generic type or model number of an asset, whereas an equipment represents an individual instance of the material. For example, Bault Robotical has four individual HX12-P1 machines with the characteristics shown in Table 7.1.

Model Number	Equipment Number	Date of Manufacture	Serial Number
HX12-P1	1000678	24.10.2007	HX00022AX
HX12-P1	1003487	16.04.2008	HX03421NB
HX12-P1	1003541	14.09.2008	HX04531OP
HX12-P1	1004056	07.10.2010	HX05554YT

Table 7.1 Example of the Difference between Equipment and Material

- **Serial number**
  As demonstrated in the preceding table, a serial number is an individual item that corresponds to a specific piece of equipment. The serial number is unique to an individual equipment and is used for tracking purposes.
- **Equipment bill of material (BOM)**
  An equipment BOM generally comprises a list of spare parts for a specific piece of equipment. An equipment BOM is specific only to one piece of equipment.
- **Functional Location BOM**
  Like the equipment BOM, a functional location BOM is generally a list of spare parts;, however, unlike an equipment BOM, a functional location BOM is (as the name suggests) assigned to a specific functional location.

An example maintenance object structure, showing some of the preceding items, is shown in Figure 7.2.

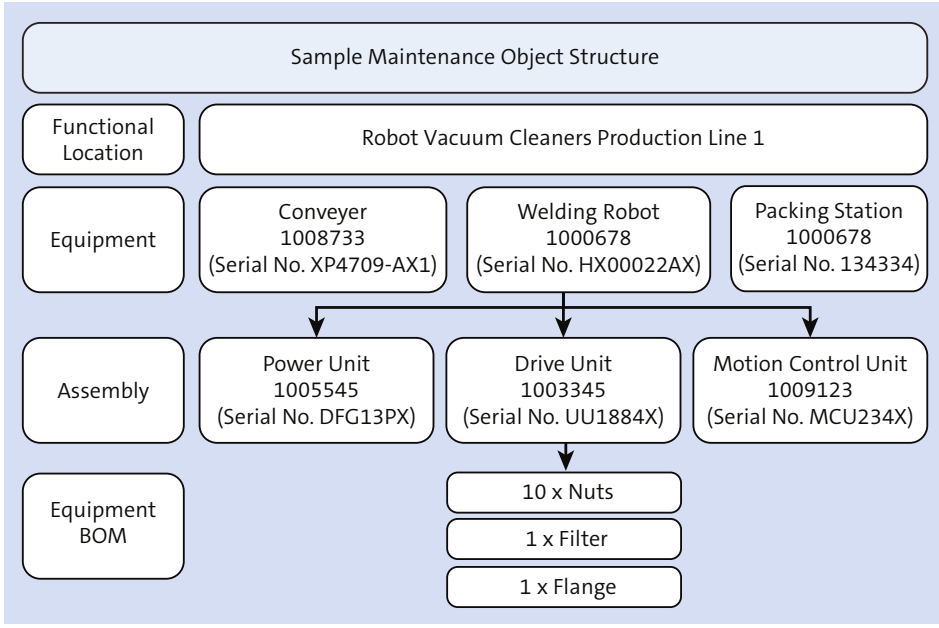
Sample Maintenance Object Structure
Functional Location
Robot Vacuum Cleaners Production Line 1
Equipment
Conveyer 1008733 (Serial No. XP4709-AX1)
Welding Robot 1000678 (Serial No. HX00022AX)
Packing Station 1000678 (Serial No. 134334)
Assembly
Power Unit 1005545 (Serial No. DFG13PX)
Drive Unit 1003345 (Serial No. UU1884X)
Motion Control Unit 1009123 (Serial No. MCU234X)
Equipment BOM
10 x Nuts
1 x Filter
1 x Flange

Figure 7.2 Example Maintenance Object Structure

Fundamentally, the SAP portfolio for asset management can be divided into two groups: functionality provided by the digital core (SAP S/4HANA Enterprise Management) and emerging functionality provided by SAP Connected Assets, as shown in Figure 7.3.

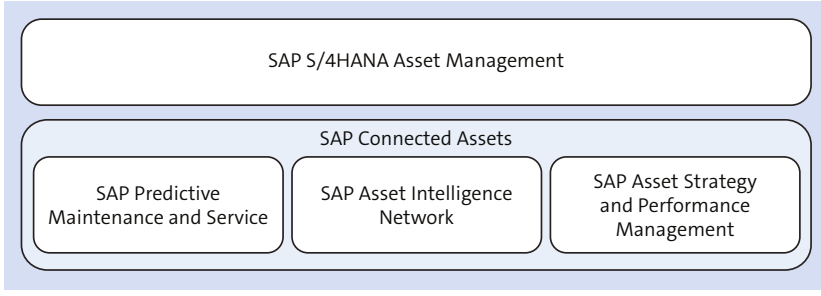
SAP S/4HANA Asset Management
SAP Connected Assets
SAP Predictive Maintenance and Service
SAP Asset Intelligence Network
SAP Asset Strategy and Performance Management

Figure 7.3 SAP Portfolio for Asset Management

These two groups will now be discussed alongside the maintenance strategies they facilitate.

Reactive Maintenance

For the purposes of this chapter, we'll outline reactive maintenance processing within the confines of SAP S/4HANA Enterprise Management.

As outlined in Section 7.2.1, the simplest function of asset management is the repair of a faulty piece of equipment after the fault has caused a breakdown. The key vehicles for this are the notification and order, which both originate inside SAP S/4HANA Enterprise Management. Notifications and orders can be created manually or automatically and are the conduit for providing both the information needed to conduct the fix and also for recording what actions have taken place. An organization may choose to use notifications and orders or only orders; many organizations use both, with the notification serving as the indicator that a repair is required, and the order being the element that facilitates and records the repair itself.

For internal malfunctions, the notification is created directly by the person who is requesting the repair (e.g., a production manager), whereas malfunctions in the field were traditionally captured by a service center that received a communication (phone call or email) from the organization requesting the fix. Figure 7.4 shows the SAP Fiori notification interface in SAP S/4HANA.

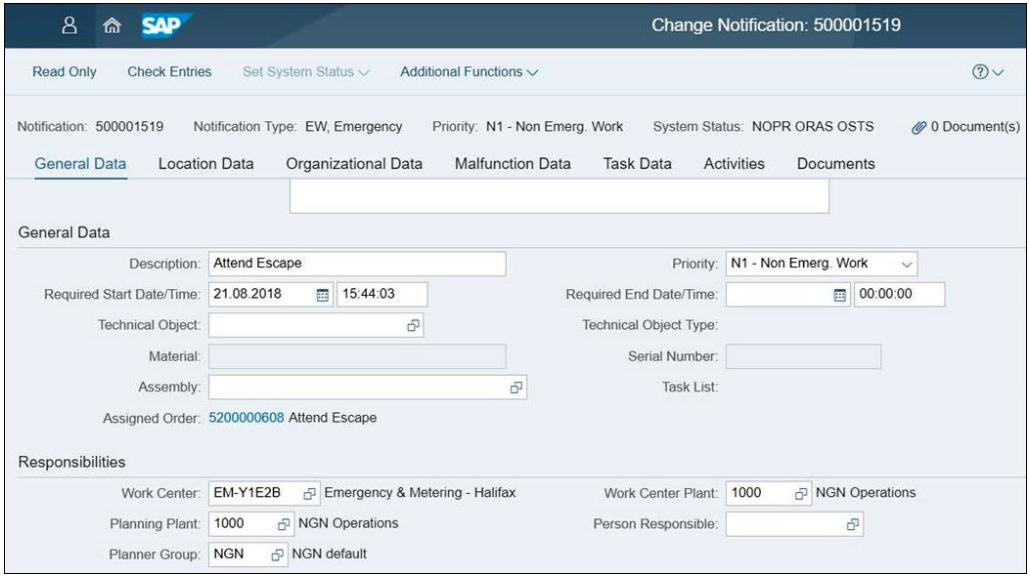

Figure 7.4 Notification Screen in SAP S/4HANA

A notification in SAP S/4HANA Enterprise Management contains the following standard information, as shown in Figure 7.5:

- **Header**
  Contains information such as the date, time, and by whom the fault was logged, and a description of the fault and the asset (equipment, functional location, etc.) when the fault has occurred.
- **Item**
  Contains information about the damage, such as the location of the damage and the cause. This information can be formulized in catalogs that provide a standard hierarchy of fault codes that facilitate better analysis.
- **Activities**
  Documents the work carried out for a notification. They provide evidence of the work performed and the results.
- **Tasks**
  Describes outstanding activities, that is, work that needs to be carried out but is yet to have been performed.

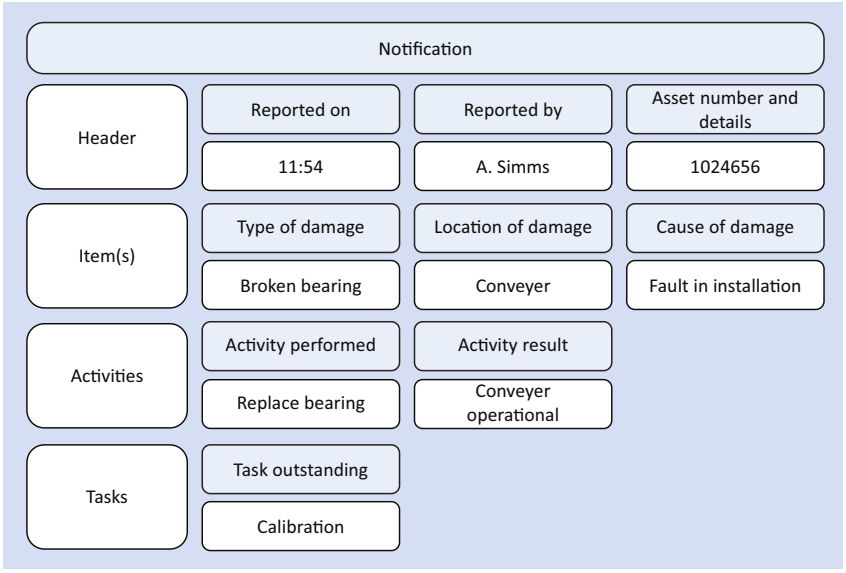

Figure 7.5 Logical Structure of a Notification in SAP S/4HANA

Once raised, the notification can be used to create the work order (as shown in Figure 7.6), which contains the following information:

- **Order header**
  Contains information such as the priority of the order, the functional location, the equipment or assembly that the work is to be carried out on, the person responsible for the order, and the operations that need to be performed.
- **Material list**
  Contains the list of materials that are required for the repair. The material list will either create a reservation for materials to be withdrawn from stock, or a purchase requisition will be generated.
- **Production resources**
  Can be thought of as materials that aren't consumed in the execution of the order. For example, at Bault Robotical, fixing robots almost invariably requires tools and protective clothing.
- **Settlement rule**
  Unlike notifications, which have no integration with finance, orders contain a settlement rule against which a cost object is assigned for the costs to settle to. The settlement rule can be assigned to the entire order, or conversely each operation can be assigned individually.
- **Cost data**
  Once again, unlike notifications, orders can be used to capture the estimated planned costs for the order together with the actual costs after work has been carried out. Variances between the versions can then be analyzed and efficiencies sorted.

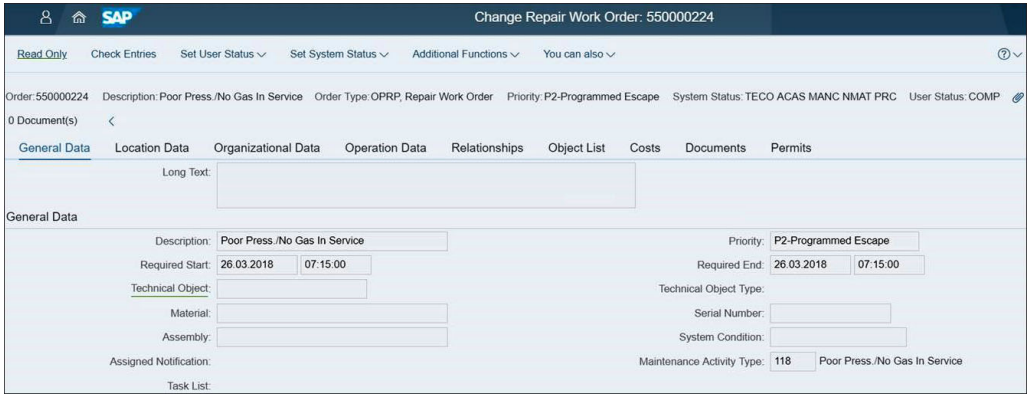

Figure 7.6 Order Screen in SAP S/4HANA

Preventative Maintenance

Together with providing the necessary functionality to support reactive maintenance, SAP S/4HANA also provides the functionality for dealing with the preventative maintenance strategy.

As we covered in Section 7.2.1, preventative maintenance is the systematic servicing of assets with the goal of reducing the possibility of failure and thus downtime of the equipment. It can be categorized into two groups: time-based maintenance and performance-based maintenance.

The key activity within preventative maintenance in SAP S/4HANA Enterprise Management is the establishment of the maintenance plan, which effectively governs the frequency of the maintenance activities. The maintenance plan brings together all the pertinent information regarding the maintenance requirements of a specific piece of equipment. After a maintenance plan exists, the SAP S/4HANA system can automatically create a work order with all the requisite order information on a date that satisfies the maintenance plan. In our simple example in Figure 7.7, the system will automatically generate an order on a six-month cycle to replace the filter on equipment XPS1543 and assign it to work center 342002 in the process.

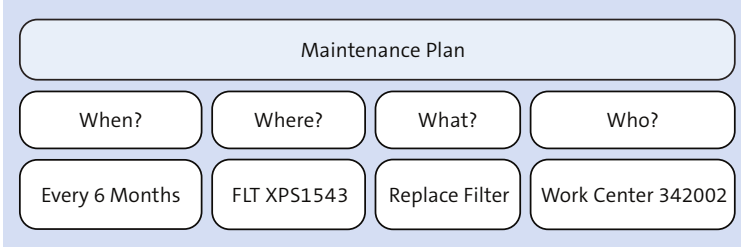

Figure 7.7 Logical Example of a Maintenance Plan in SAP S/4HANA

Time-based plans, as described in Section 7.2.1, simply prescribe an elapsed period of time between maintenance activities; for example, a forklift truck must be maintained every six months. A performance-based plan is intended to schedule maintenance based on the usage of an item; if an asset is subject to heavy usage, then the scheduling of maintenance will be accelerated, while the opposite is equally true. Within SAP S/4HANA Enterprise Management, this involves the assignment of a counter to the asset (forklift truck) technical object. Maintenance takes place when this reading is reached, for example, after 1,000 hours of operation.

The maintenance plan consists of the following elements:

- **Maintenance strategy**
  The maintenance strategy defines the rules for the cycle of the planned work and contains general scheduling information and additional data that can affect scheduling. The following are examples of time-based preventative maintenance strategies:
  - Maintenance should be carried out every 1,000 operating hours
  - Maintenance should occur every three months
  - Maintenance should be performed once year
- **Maintenance item**
  A maintenance item outlines the tasks that must take place regularly at a technical object or group of technical objects. Examples of maintenance items include the following:
  - Perform safety test
  - Replace bearings
  - Calibrate instruments

Predictive Management

In this section, we'll discuss at length how the focus from SAP and the industry in general is moving toward the adoption of a predictive model of asset maintenance. In doing so, we'll discuss evolving technologies, such as IoT and machine learning, and discuss business networks that connect all relevant actors pertinent to the lifecycle of assets. From an SAP perspective, we'll move our discussions from within SAP S/4HANA Enterprise Management to an emerging set of functionality currently bundled together under the heading of SAP Connected Assets.

However, before we get into the SAP side of predictive management, let's take a closer look at some of the technical innovations that have both enabled this adoption of preventative maintenance strategies and also underpin the SAP technologies in this area:

- **IoT**
  Unlike traditional boundaries today, asset management isn't restricted by the technologies used to link assets to business systems, with the assets being linked through the Internet. This brings standardization to the communication layer, which, in turn, enables organizations to publish information directly to the

Internet. As a result, every asset can become part of the IoT. In tandem with the standardization of communication, assets themselves are becoming smarter and now able to indicate status, information, send failure codes, and alerts when maintenance is required. The result is an ever-increasing ocean of data that contains valuable insight into the condition of each asset at any point in time.

- **Big data and analytics**
  The growing intelligence of assets coupled with the ability to communicate this data via the Internet means that asset-intensive organizations now collect huge amounts of data that, once mined, can provide valuable insights into the status of their asset networks. While the quantity of data generated today is remarkable, it will only grow as the price of sensors, microprocessors, and wireless technologies continue to fall. Even today, the cost has dropped to a point where it's affordable for companies to turn not just costly sophisticated assets but also smaller machines and even household appliances into smart assets.
- **Mobile technology**
  The introduction of mobile technology has enabled installers, engineers, and service organizations to access crucial information anytime and anywhere. This means that vital information and communication can be accessed regardless of where the asset is geographically deployed.

As the feasibility of mainstream adoption of predictive maintenance is predicated on the technology outlined here, it should come as no great surprise that SAP's solutions in this area are themselves founded upon the package of technologies and services SAP calls SAP Leonardo. Specifically, here we're focusing on one of the six SAP Leonardo packaged solutions: SAP Connected Assets (shown in Figure 7.8).

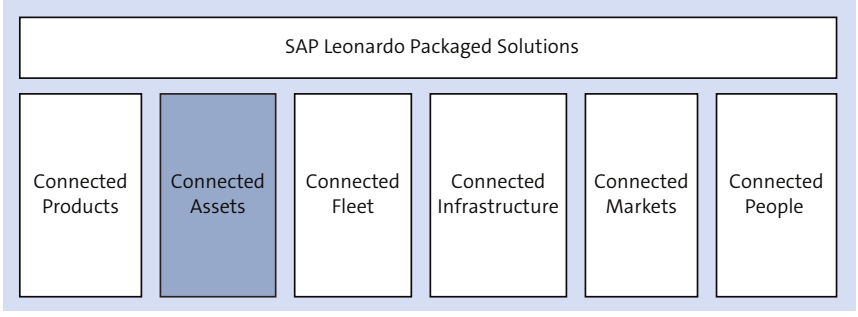

Figure 7.8 SAP Leonardo Packaged Solutions

SAP Connected Assets consists of the following key elements:

- SAP Predictive Maintenance and Service
- SAP Asset Intelligence Network
- SAP Asset Strategy and Performance Management

SAP Predictive Maintenance and Service provides an organization with a single control center for managing all aspects of its asset network, including sensors, business data, and third-party data. From this central control center, an organization can continually collect and analyze sensor data in real time to monitor asset status and health. This information can be fed into advanced analytics models to predict future failures. The solution can also determine the potential root cause of expected failures, trigger corrective work orders, order spare parts, and even assign the correct skills resources.

As outlined by Figure 7.9, the solution can be thought of as being split into four segments that cover the entire process from the harvesting of sensor data through to the interpretation of this data into just-in-time (JIT) maintenance activities:

- **Sensor**
  Connecting sensors to be able to harvest data.
- **Data**
  Integrating sensor data coming in.
- **Insight**
  Interpreting the data through the use of condition-based monitoring and machine learning:
  - Condition-based monitoring: This is essentially the monitoring of inputs and checking tolerance against a predefined set of thresholds.
  - Machine learning: Machine learning is used to identify patterns of malfunction.
- **Action**
  Creating maintenance requests, orders, and other administrative tasks based on the insights provided.

The resulting information is brought together in the Asset Health Control Center, as shown in Figure 7.10. The Asset Health Control Center is a central dashboard that provides the maintenance planners with a view of the health of all assets. It shows medium and high alerts, which represent pending or potentially imminent asset failures, respectively. It then allows the operators to drill down into specific assets to understand the history of the assets and to schedule corrective action if required.

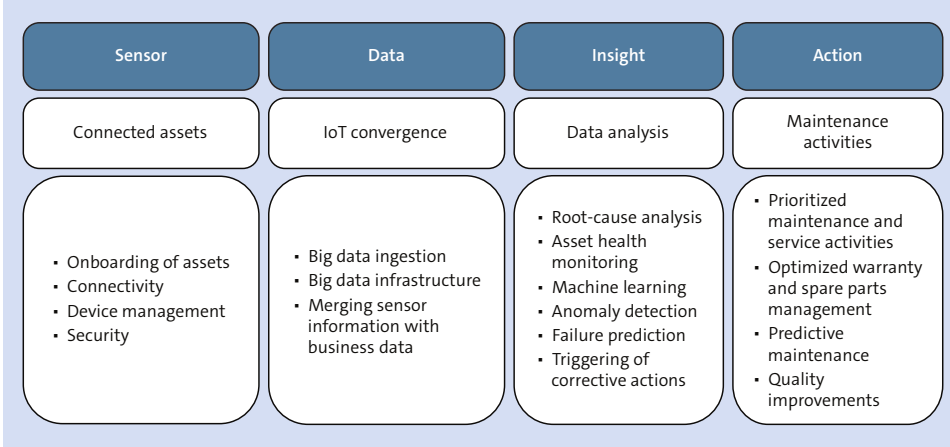

Figure 7.9 Functionality within SAP Predictive Maintenance and Service

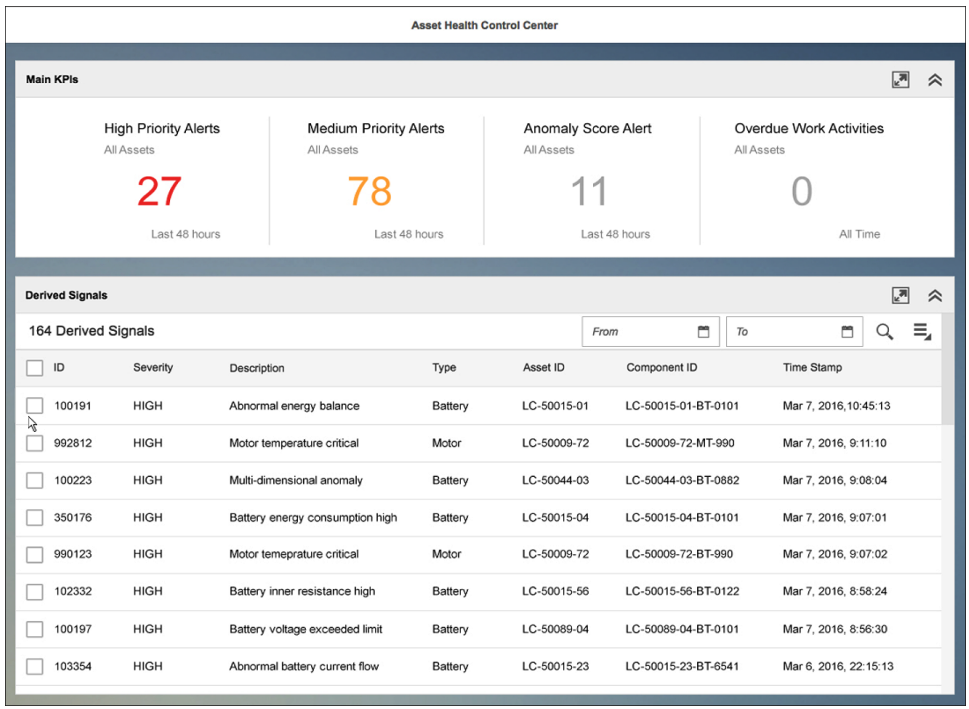
Asset Health Control Center
Main KPIs
High Priority Alerts
All Assets
27
Last 48 hours
Medium Priority Alerts
All Assets
78
Last 48 hours
Anomaly Score Alert
All Assets
11
Last 48 hours
Overdue Work Activities
All Assets
0
All Time
Derived Signals
164 Derived Signals
From
To
ID Severity Description Type Asset ID Component ID Time Stamp
100191 HIGH Abnormal energy balance Battery LC-50015-01 LC-50015-01-BT-0101 Mar 7, 2016,10:45:13
992812 HIGH Motor temperature critical Motor LC-50009-72 LC-50009-72-MT-990 Mar 7, 2016, 9:11:10
100223 HIGH Multi-dimensional anomaly Battery LC-50044-03 LC-50044-03-BT-0882 Mar 7, 2016, 9:08:04
350176 HIGH Battery energy consumption high Battery LC-50015-04 LC-50015-04-BT-0101 Mar 7, 2016, 9:07:01
990123 HIGH Motor temeprature critical Motor LC-50009-72 LC-50009-72-BT-990 Mar 7, 2016, 9:07:02
102332 HIGH Battery inner resistance high Battery LC-50015-56 LC-50015-56-BT-0122 Mar 7, 2016, 8:58:24
100197 HIGH Battery voltage exceeded limit Battery LC-50089-04 LC-50089-04-BT-0101 Mar 7, 2016, 8:56:30
103354 HIGH Abnormal battery current flow Battery LC-50015-23 LC-50015-23-BT-6541 Mar 6, 2016, 22:15:13

Figure 7.10 Asset Health Control Center

We'll now discuss the other two elements of the SAP Connected Assets solution.

7.3 Asset Operations

Up to this point in the chapter, we've assumed that the only people who have an interest in the health of the assets belong to the organizations that run and maintain them. However, in reality, this is often far from the truth with various actors having a vested interest in the management and maintenance of assets. For example:

- Manufacturers of the assets have a vested interest to ensure that information about the breakdowns and usage information is captured to ensure that the correct spare parts and operating instructions are available to meet the needs of the organizations operating them.
- Operators of the assets need information such as operating instructions and information pertaining to servicing.
- Service providers often maintain assets on behalf of the companies that are operating them. In this scenario, access to maintenance plans and instructions together with information pertaining to breakdowns is crucial to the successful and speedy maintenance and repair of assets.

In this section, we'll take a look at how asset management is performed in this context, with a focus on SAP Connected Assets.

7.3.1 SAP Asset Intelligence Network

Traditionally, business systems such as SAP ERP have focused internally on the processes within an individual business and haven't shared or collaborated outside of their walls. While this helped to coordinate intracompany processes and activities, it did little to embrace collaborative working outside of those confines. Conversely, however, business networks are now developing that are specifically intended to facilitate core interactions between businesses. The use of business networks within an asset management context is starting to gain traction and is following a trend already established in procurement where SAP runs the procurement business network Ariba. SAP's asset management equivalent to SAP Ariba is called the SAP Asset Intelligence Network.

The SAP Asset Intelligence Network provides a subscription-based central repository (Asset Intelligence Repository) where manufacturers, operators, and service providers share information, such as technical asset- and maintenance-based information. It also allows for the delivery of both structured and unstructured information to the

operator throughout the asset lifecycle. Furthermore, from a manufacturer perspective, it can collect, track, and trace equipment information, including receiving asset usage and information and failure data.

As shown in Figure 7.11, SAP Asset Intelligence Network provides a single global repository for equipment information (including information mastered within SAP S/4HANA) and additional information together with other information that can be retrieved from third parties or the other members of the SAP Connected Asset family (SAP Predictive Maintenance and Service and SAP Asset Strategy and Performance Management).

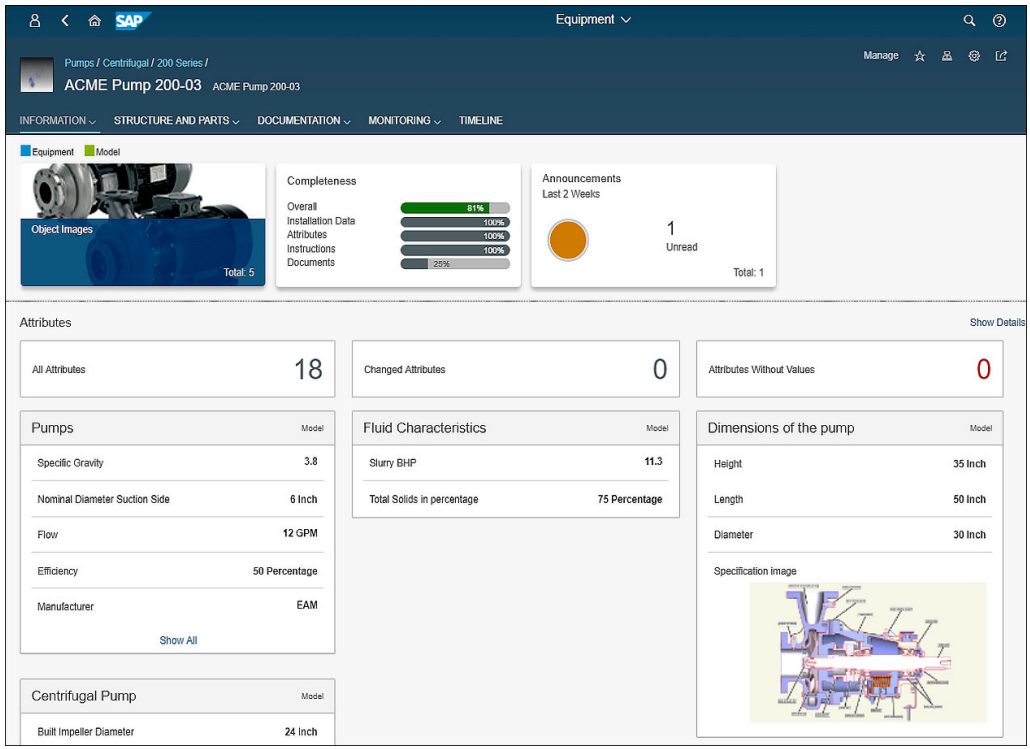

Figure 7.11 SAP Asset Intelligence Network

7.3.2 SAP Asset Strategy and Performance Management

On February 12, 2018, SAP announced the release of another member of the SAP Connected Assets family: SAP Asset Strategy and Performance Management. As the name suggests, this solution is intended to help organizations define, plan, and monitor

their maintenance strategies. Put simply, while SAP Predictive Maintenance and Service allows for the adoption of a predictive approach to asset maintenance, SAP Asset Strategy and Performance Management provides the information an organization needs to decide which model to associate with which type of asset.

SAP Asset Strategy and Performance Management facilitates this in the following ways:

- **Asset information management**
  SAP Asset Strategy and Performance Management allows asset information to be uploaded from SAP ERP, SAP S/4HANA, or any non-SAP ERP systems. After asset records are imported, organizations can use SAP Asset Strategy and Performance Management to evaluate their reliability, availability, and maintainability.
- **Risk and criticality management**
  SAP Asset Strategy and Performance Management helps organizations calculate risk scores based on various dimensions and impact categories. From this, organizations can categorize asset criticality based on risk score, and from this score, they can select the most appropriate risk analysis method.
- **Failure modes and effects analysis**
  SAP Asset Strategy and Performance Management also enables organizations to better recognize potential future failures together with identifying and suggesting actions to reduce the likelihood of these failures.

7.4 The Road Ahead

In the context of asset management, the road ahead is already here in the form of SAP Leonardo and specifically the ever-emerging SAP Connected Assets suite. This emerging solution suite is seeking to embed the latest technology, such as IoT and machine learning, into the core business processes of today's organizations. By using the capabilities of SAP Leonardo, this suite is endeavoring to transform asset management from one that is based on either reactive or routinely scheduled processes to one that is based on ever-evolving complex predictions. Assuming that this functionality drives the expected cost- and time savings, a new normal will be created where the ability to predict failure and malfunctions will lead to both cost reductions in terms of maintenance and the minimization of lost revenue caused by asset malfunction.

However, IoT and machine learning are only one side of the equation as SAP Connected Assets and, in particular, the SAP Asset Intelligence Network continue SAP's

expansion into intelligent business networks. Following the path already trodden by SAP acquisitions, including Ariba and Concur, the SAP Asset Intelligence Network once again reinforces SAP's desire for enterprises to move beyond the confines of the organization itself and into a connected, mutually beneficial ecosphere.

In terms of the SAP Asset Intelligence Network, this mutually beneficial network should allow manufacturers to make better products through the collection of usage and fault data, allow operators to operate safely, and enable service providers to provide more cost-effective maintenance.

It's also clear, however, that SAP's evolution of asset management won't stop with the current SAP Connected Assets portfolio. In fact, at the time of writing, SAP is beginning to market SAP Predictive Engineering Insights, which leverages the "digital twin" technology obtained during the acquisition of Fedem Technology.

In the next chapter, we'll move on to our final focus of operations: research and development (R&D).

Chapter 8

Research and Development with SAP S/4HANA

It isn't all white lab coats and test tubes in research and development, and this chapter looks at how the next generation of SAP solutions can improve your efficiency and effectiveness in finding the "next big thing" for your business.

The rapidly evolving digital landscape and personalized customer demands have created a fundamental change in the way new products are developed and launched. New ideas, product usage information, and requirements from customers are continuously flowing into research and development (R&D) processes. To manage this flow and to meet the demands of customers wanting more and more customized products, companies need to bring these inputs together with an innovation platform. To be effective, the platform must provide visibility of the R&D process from the idea stage through the prioritization of initiatives and the managing of projects to successful completion. One such platform is SAP S/4HANA.

R&D functionality in SAP S/4HANA allows companies and R&D organizations to prepare their downstream processes to make, sell, and maintain the products that the R&D function creates. It also supports the iteration of innovations to improve profitability, product reliability, and desirability through four key product areas, as shown in Figure 8.1. The R&D pipeline takes initial ideas through development and implementation and on to the manufacturing and sale of the end product. Eventually, the delivered innovation will become obsolete or replaced by new innovations and be retired.

Each of these areas is covered by a specific module or modules of R&D functionality in SAP S/4HANA:

- SAP Innovation Management covers ideation and concept development.
- SAP Product Lifecycle Costing supports product development.

- SAP Portfolio and Project Management supports the delivery of projects, both internal and commercial.
- The R&D functionality in SAP S/4HANA embeds support for compliance across the application.

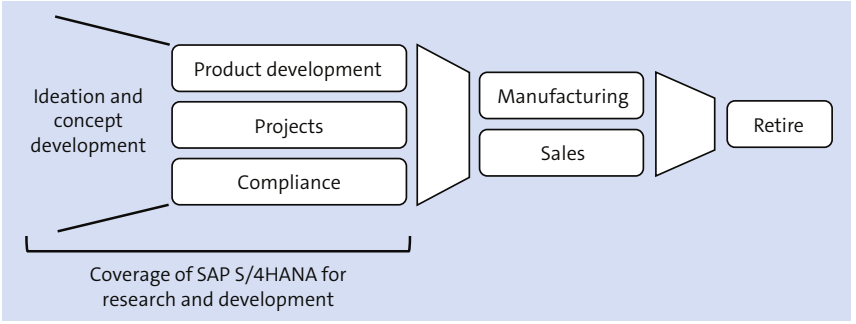

Figure 8.1 R&D Pipeline

The three main activities that are critical to R&D organizations and departments are as follows:

- **Development and introduction of new products**
  Take ideas from generation through prioritization into design and development. Introduce products that excite customers and satisfy regulatory requirements ever faster to market.
- **Personalization of products**
  Design and manufacture personalized products at similar costs and lead times to off-the-shelf products, meeting customer demands and managing cost-to-fulfill.
- **Delivery of customer projects**
  Take customer projects from opportunity to planning to execution, before final delivery to the customer with a keen focus on profitability at every stage.

We'll now return to our business case to look at Bault Robotical's approach to R&D before reviewing the four elements of the R&D functionality in SAP S/4HANA. In this chapter, we'll cover SAP Innovation Management, SAP Product Lifecycle Costing, SAP Portfolio and Project Management, and SAP Commercial Project Management. Finally, we'll take a look at the road ahead for this area.

8.1 Business Case

As Bault Robotical looks to reside on the cutting edge of robotics, it's somewhat unsurprising to find that it has a significant R&D capability with strong links to local universities. What probably is surprising is to find that it hasn't had a direct link into its backend ERP to date, which is something that the leadership of Bault Robotical wants to change because they see R&D as one of the key drivers in their business.

The aims of the business were twofold: First, Bault Robotical wanted to be able to drive better visibility of what is going on within R&D without significant overheads. Second, because the company employs a lot of bright people, they wanted to better tap into the thoughts and ideas of their workforce with R&D being currently viewed as a bit of a closed shop.

To achieve these aims, Bault Robotical chose to fully implement the capabilities of the R&D functionality in SAP S/4HANA, alongside a number of change management activities. In particular, thery focused on a cultural shift to ensure that the statement "no idea is a bad idea" rings true within the organization and that they get full adoption for innovation management and in particular the idea community.

Other aspects of the deployment were seen as trying to put some consistency and rigor into the processes around delivering customer projects because each project seems to adopt its own ways of working, making comparisons of project performance difficult and creating barriers that prevent the optimal deployment of its workforce. Each project has to effectively onboard resources from other project teams, even though they are part of the same company!

8.2 Innovation Management

Arguably the most important aspect of an R&D function is its ability to generate and deliver new innovations, and this starts with an idea. Ideas aren't the sole prerogative of R&D and can come from any part of the company—from the field engineer dealing with repeating issues, to the sales team members who are out engaging with your customers, or in fact anywhere in your organization. So how do you tap into the collective intelligence of your workforce? How do you make sure that the idea that could transform your company isn't missed?

This is where SAP Innovation Management comes in to play its part as, essentially, a suggestion box on steroids. It allows ideas to be collected, developed through community-based collaboration, and eventually linked into SAP Portfolio and Project

Management for successful ideas to be made into a reality. Where SAP Innovation Management differs from a suggestions box is the ability to collaborate across the company on an idea within the Innovation Community, manage the development of ideas through the Innovation Office, and ideate on the go with the provision of a mobile app.

SAP Innovation Management looks to solve a number of innovation challenges by doing the following:

- Break down corporate silos to allow the free flow of ideas.
- Provide a repository of ideas that can be searched and referenced.
- Enable community-based collaboration on ideas.
- Create effective innovation management though the Innovation Office.

SAP Innovation Management looks to keep the submission of ideas as simple as possible, as you can see in Figure 8.2, but it also allows users to look for similar ideas. Here we're submitting an idea for improving component tracking with blockchain, and we can see a number of supply chain ideas have been flagged as similar.

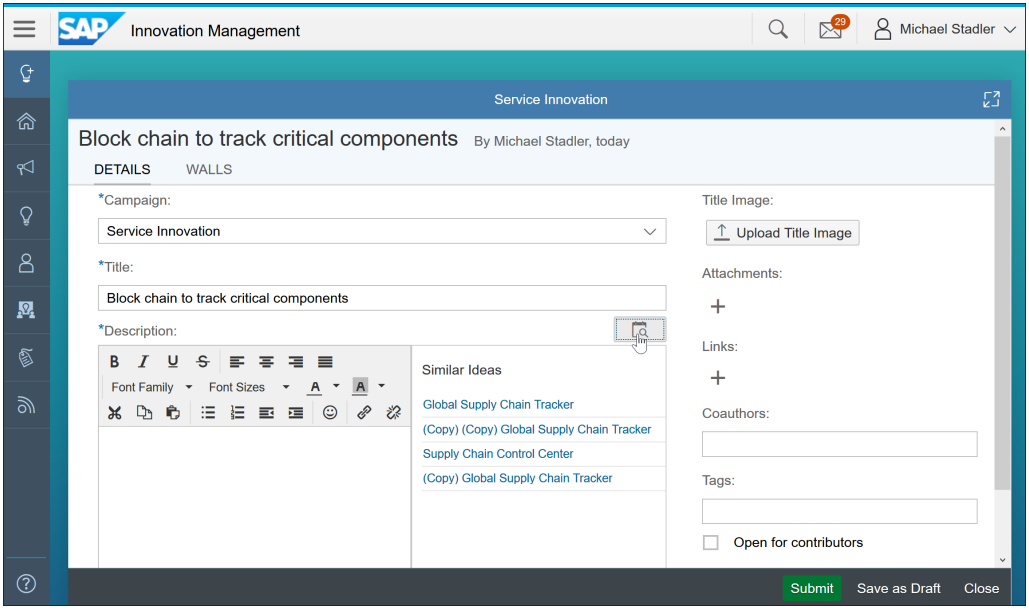

Figure 8.2 Creating an Idea with SAP Innovation Management

After an idea has been submitted, it's open to the Innovation Community to comment and vote upon, and when an idea has sufficient support or has been identified as having significant potential, it can be picked up by the Innovation Office. The Innovation Office provides an idea coach who helps to guide the idea through the innovation process, bringing in experts within the business to collaborate on its development (see Figure 8.3). The Innovation Office can also run campaigns for ideas in key areas; for example, if your company is struggling in the supply chain area, a focused campaign for ideas in this space could be run to generate ideas as to how this area could be improved.

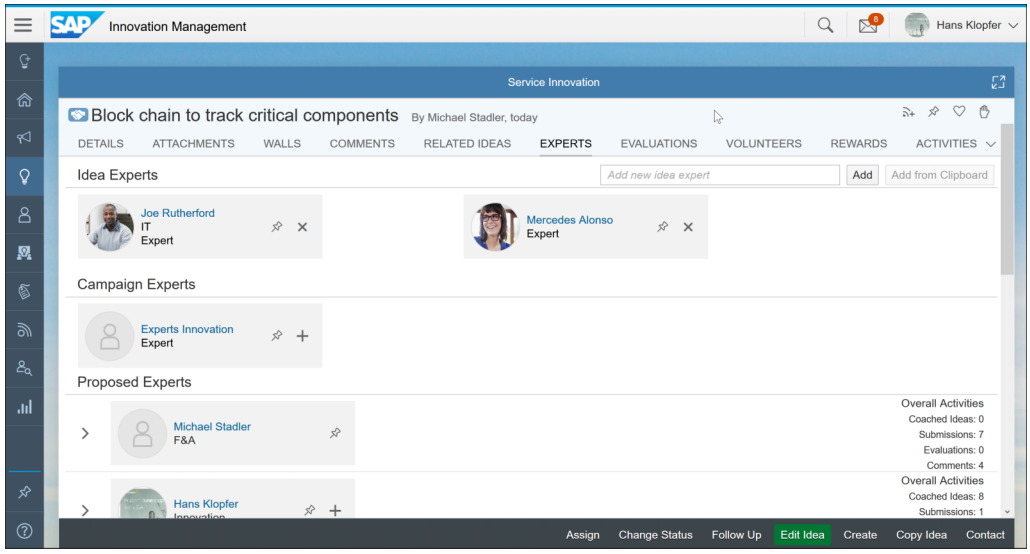

Figure 8.3 Bringing in Company Experts to Work on an Idea within SAP Innovation Management

SAP Innovation Management also offers the ability to report on your innovations, as shown in Figure 8.4. Here you can see standard reporting covering numerous metrics, including top voters, campaign activity, ideas by campaign, and so on. You can also see where you're short of ideas or suffering from an abundance, and tailor your innovation offices activity as appropriate.

Through the easily accessible and collaborative platform of SAP Innovation Management, alongside the innovation processes and management capability of the Innovation Office, your company can improve the way in which it gathers and develops ideas from thought to product.

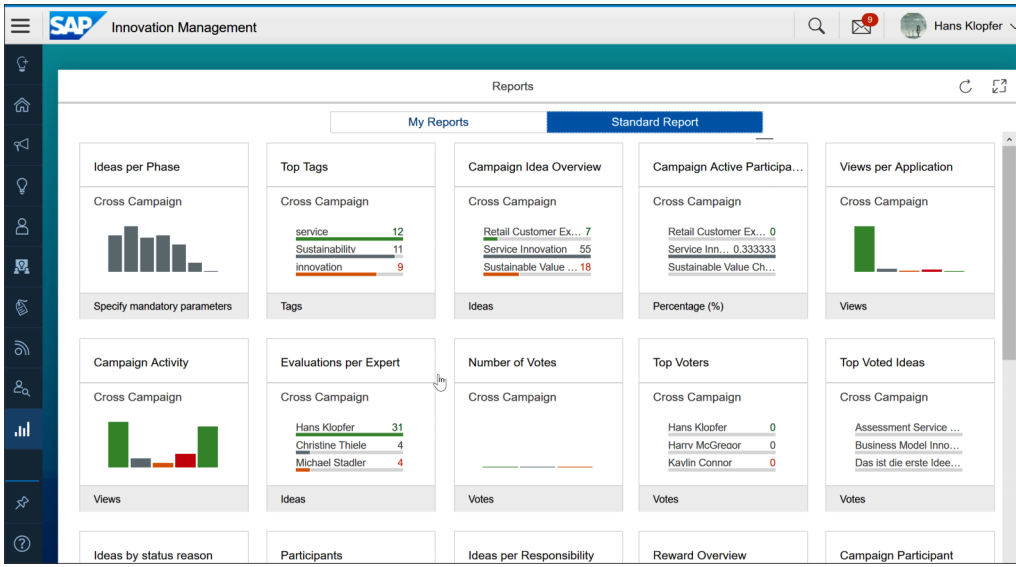

Figure 8.4 Standard Report in SAP Innovation Management

8.3 Product Lifecycle Costing

One of the most critical aspects of innovation is its cost to produce. As no matter how clever or groundbreaking the product is, it has to be cost effective to produce and as a result offer good value to potential customers. Therefore, being able to quickly assess cost and refine products to reduce costs is an essential differentiator within R&D. This is where SAP Product Lifecycle Costing comes into its own by calculating costs and other dimensions for new products or quotations in the early stages of the product lifecycle, identifying cost drivers throughout the lifecycle, and simulating alternatives for comparison. It can also be used for preliminary cost estimates, quotation costing, and lifecycle costing.

SAP Product Lifecycle Costing for SAP S/4HANA supports three costing scenarios within the product lifecycle. Figure 8.5 shows where each fits within the product lifecycle.

Each scenario is detailed in the following list:

- **Preliminary cost estimates**
  Whether for new part introduction (NPI) or for the creation of a successor product as part of continuous improvement (CI), SAP Product Lifecycle Costing allows cost,

cost breakdowns, and cost drivers to be identified and assessed ahead of manufacturing. The cost model and therefore the product design can be iterated to find the optimal cost versus quality balance.

- **Quotation costing**
  Quotation costing is commonly linked to customer enquiries for the manufacture of complex custom solutions or composite solutions containing multiple products. SAP Product Lifecycle Costing can handle the inevitable customer revisions as well as product or project scope changes, helping to prepare alternative cost calculations, outlining the differences in the cost structure by comparing the original quotation with the revision, and allowing your company (and its customers) to have early sight of the cost of changes before committing to a specific change.
- **Lifecycle costing**
  Lifecycle costing is used in situations where costs of a product or solution are required to be estimated over a period of time. SAP Product Lifecycle Costing accounts for variances in volume, prices of components and raw materials, labor, and currency exchange. SAP Product Lifecycle Costing has particular relevance for automotive suppliers who need to maintain profit margins over contracts that cover months or even years of production.

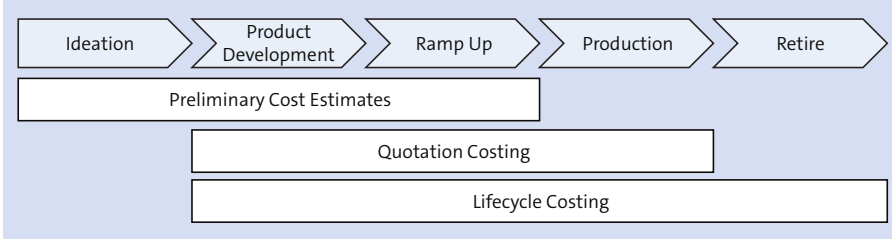

Figure 8.5 Costing Scenarios within the Product Lifecycle

What's Right for You?

Because SAP Product Lifecycle Costing can be deployed as part of SAP S/4HANA or as a standalone solution, it not only can integrate with data from SAP S/4HANA and SAP Product Lifecycle Management—for example, bringing in a bill of materials (BOM) for existing products for revision—but you can also bring data in via Microsoft Excel (using SAP templates) or via integration to the SAP Product Lifecycle Costing application programming interface (API) from third-party applications.

Therefore, you can make use of SAP Product Lifecycle Costing whether you have SAP S/4HANA at your core, have a previous investment in SAP Product Lifecycle Management, or use another toolset entirely. This flexibility in terms of deployment and connectivity allows you to implement SAP Product Lifecycle Costing as an early value demonstrator within a wider SAP S/4HANA transformation program, alongside or after the main deployment of SAP S/4HANA or simply as an independent application depending on the needs and strategic direction of your organization.

Being able to make use of existing data within the enterprise is key to the accuracy and flexibility of SAP Product Lifecycle Costing, as is the ability to estimate on incomplete data during the early stages of the product lifecycle, that is, from incomplete BOMs, temporary materials, or changing overheads. SAP Product Lifecycle Costing manages this by creating multiple calculations to build up to an overall cost (see Figure 8.6) with each calculation able to be versioned so that users can combine differing versions together to produce different cost models that can be compared to optimize product quality and profit margins.

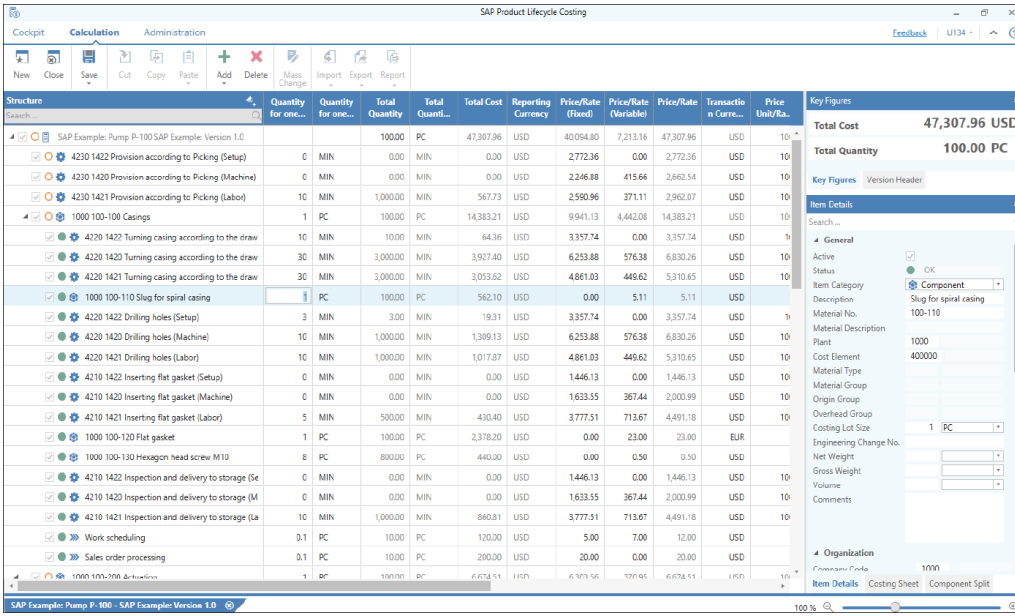

Figure 8.6 Example of a Calculation in SAP Product Lifecycle Costing

8.4 Portfolio and Project Management

R&D organizations are primarily project-driven, as once a new idea has been developed sufficiently to be put into production, it's typically done via a project. As such, organizations need to be able to schedule and manage resources (e.g., people) in such a way that projects are completed within defined scope, quality, time, and cost constraints. This makes the functionality available within SAP Portfolio and Project Management of significant benefit, not only through the application of project management disciplines but also as SAP Portfolio and Project Management captures projects within SAP S/4HANA itself (SAP Portfolio and Project Management for SAP S/4HANA). This feature brings enterprise management and project management together.

Even without any integration with SAP S/4HANA, simply moving away from a spreadsheets and ad hoc tools approach to SAP Portfolio and Project Management generates a number of benefits:

- **Project team coordination**
  SAP Portfolio and Project Management provides a number of collaboration tools that enable the project team to contribute to the project without any significant cost, regardless of their physical location. This includes a series of SAP Fiori apps to allow the project team to pick up assigned tasks and record their progress.
- **Centralized monitoring and control**
  SAP Portfolio and Project Management simplifies monitoring and control of a project, as the current status of your projects are surfaced through project manager-focused SAP Fiori apps with the capability of comparing actual status with the baseline and flagging where the project is falling behind (or going full steam ahead!).
- **Project data consolidation**
  SAP Portfolio and Project Management provides a single location for all project data with real-time updates and support for project document management.
- **Reliable and standardized reporting**
  SAP Portfolio and Project Management provides support for standard and ad hoc reporting based on the consolidated view of the project. This allows the project team to focus on actioning the insights derived from the project reporting and delivering a great result rather than gathering and collating the reports.

SAP Portfolio and Project Management delivers these benefits through a highly integrated solution that combines the following aspects:

- **Portfolio management**
  A portfolio level view of your R&D projects enables better control and the ability to innovate around processes, products, and services across their lifecycles. By integrating information from project management, human resources, and financial systems, portfolio management gives high-level visibility over the entire portfolio of company projects. It allows your organization to avoid delays and identify redundancies that may occur, as information is collected from disparate sources and combined into dashboards that act as a starting point for portfolio analysis.
- **Project management**
  SAP Portfolio and Project Management looks to provide consistent and repeatable processes for the management of projects, enabling a strong project management function that includes project planning and execution as well as project accounting. Project management provides tools to structure, schedule, and visualize projects with different implementation approaches.
- **Resource management**
  You can optimize human resource deployment within a project as well as across multiple concurrent projects. Resource management focuses on using the employees efficiently and assigning them to projects based on demand, qualifications, and availability. This allows your R&D organization to maximize the use of the right resources on the right projects, increasing both project throughput and the use of appropriate resources on your projects.

We'll return to SAP Portfolio and Project Management in an IT project context in Chapter 19.

8.5 Commercial Project Management

While all projects have a commercial impact, those that are being delivered for a customer have additional commercial facets that require close management and monitoring. This can be especially challenging if project-related data and processes are distributed over multiple tools and applications. Many processes (e.g., project estimation, forecasting, issue management, change management, and risk management) are often supported by Excel or specialized third-party solutions that are often

not integrated with the SAP ERP backend or each other. This leads to a number of challenges:

- Inconsistent approach to estimation, planning, and forecasting
- Lack of transparency and consistency across different tools
- Delays and difficulties in project reporting due to delayed synchronizations and manual reconciliation
- Limited ability to gather lessons learned from previous projects
- Inconsistent change management approach negatively impacting project margins
- Project managers spending too much time on administration and internal activities

It may appear at first glance that SAP Portfolio and Project Management would be ideally placed to solve these challenges, and, to some extent, this is true. However, SAP Portfolio and Project Management doesn't account for the commercial aspect of running customer projects. This is where SAP Commercial Project Management excels. SAP Commercial Project Management sits at the project execution level, alongside the project management aspects of SAP Portfolio and Project Management, and supports the four phases of commercial projects: sell, plan, execute, and monitor and control.

SAP Commercial Project Management provides an integrated view of projects by bringing a unified view of related business objects from opportunities (pulled from SAP C/4HANA or other customer relationship management [CRM] applications) to sales and distribution (SD) orders and project system (PS) projects, as well as project management specific objects such as estimates, forecasts, change requests, and issues in a single master project object. SAP Commercial Project Management makes the most of this integrated view through three key capabilities:

- **Project Workspace application**
  This can be viewed as the hub of SAP Commercial Project Management, enabling project management activities such as resource management, contracts, billing, and status reporting. The Project Workspace app includes embedded analytics, providing specific SAP Commercial Project Management outputs such as progress reports, work in progress (WIP) reports, and project cost overview reporting (enhanced in SAP S/4HANA release 1709 with new key performance indicators [KPIs] around pending revenues from change requests, remaining commitments, and other topics).

The Project Workspace application also contains a contract management functionality, consisting of the billing cockpit and billing plan management. These functionalities provide close control of billing and ensure compliance with contractual terms and conditions—after all being paid in a timely manner for your work is a key outcome for companies looking to deliver projects for their customers.

You can also define rule-based alerts within Project Workspace based on key project factors such as planned vs. actual effort, billings due, number of change requests, and so on. These rule-based alerts are designed to both identify projects that are straying out of prescribed parameters and to ensure key activities are carried out in a timely manner.

- **Project cost and revenue planning**
  One of the key differentiators between SAP Portfolio and Project Management and SAP Commercial Project Management is the ability of SAP Commercial Project Management to take projects costs from high-level estimates and bid estimates in the sell phase to contract booking and baseline planning. After a project is in flight, financial plans can be versioned as aspects of project change, and these versions can be compared and are also the basis of SAP Commercial Project Management's ability to estimate the cost of change.

  Project cost and revenue planning also unifies the planning of all aspects of the project lifecycle: resources, materials, expenses, and third-party costs. Armed with the ability to financially model and compare plans gives your project managers visibility and control over the profitability of your projects, as well as gives your customers an accurate view of their projects costs.

- **Project issue and change management**
  Alongside the financial and overall management of projects, SAP Commercial Project Management deals with two of the critical elements within project management: issues and change. Project issue and change management allows project issues to be logged and then managed. Issues can result in a change to scope or an impact on the budget, timeline, or resources needed to execute the project.

  Change requests are also created within project issue and change management. Once created, users can assess the change, propose solutions (as well as estimate the costs involved with project cost and revenue planning), and run them through an approval process because enabling uncontrolled change inevitably leads to uncontrolled scope and costs. Change requests can also be grouped within collective change requests, allowing linked change requests to be processed as one.

On the creation of project issues or change requests, activities can be automatically generated or created free form to assign actions to resources, for example, to generate a cost estimation for a new change request after a proposed solution is available.

SAP Commercial Project Management arms your project managers with detailed insights into their projects and provides your business with repeatable and reliable processes to effectively estimate and then manage costs and control change.

What's Right for You?

We've detailed both SAP Portfolio and Project Management and SAP Commercial Project Management in this chapter, which have significant crossover in terms of enabling R&D project management—but which of these applications is right for you? Essentially, the selection will boil down to whether you're running projects internally (in other words, your company is its own customer) or externally (you have an external customer) because SAP Commercial Project Management is focused on those projects being delivered externally, whereas SAP Portfolio and Project Management is focused on internal projects.

8.6 The Road Ahead

Like many of the products and capabilities we've discussed, there is a reoccurrence of some common themes around adoption of cloud technology, embedding machine learning, development of simpler object models, and better user experience through full adoption of SAP Fiori—all of which resonate with the direction being followed in the R&D space.

One theme that is not as common is the development of the Project Intelligence Network. Although initially focused on construction projects, this looks to recognize the growing strategic importance of the "networked economy" in that the collaboration of many businesses partnering together, bringing their own specialisms, can deliver significant and groundbreaking initiatives. Enabled by cloud technology, this is something that will continue to develop around the SAP Portfolio and Project Management elements of the R&D functionality in SAP S/4HANA.

The adoption of machine learning capabilities cuts across the product set, with the use of machine learning for project forecasting, innovation idea selection, recipe data, and

intelligent compliance in all items within the SAP Road Map. In each case, the use of machine learning looks to improve the outcomes of the relevant process and give your organization greater insight and intelligence around its decision-making.

Next, we'll switch gears to explore the financials line of business, starting with financial accounting.

PART III

Financials

Chapter 9

Financial Accounting with SAP S/4HANA

This chapter introduces some of the key financial accounting (FI) topics to those of us to whom finance isn't a friend! It's written to outline finance from 10,000 feet and discusses the facets of the major FI business processes and how they are facilitated by SAP S/4HANA.

The current business environment in general is highly volatile, uncertain, complex, and ambiguous (VUCA), making the role of the CFO and its finance function extremely pertinent in finding innovative ways of effectively and efficiently allocating precious resources while remaining competitive.

Finance as a function equates to knowledge of a business; it highlights how a business is performing and how best it should plan for the future. As such, if any business wants to have the requisite agility and dexterity to compete in the digital world, it will need to process more information more efficiently and be able to analyze and use the information to provide insight.

To a lot of people, finance is just a numbers game. However, the next two chapters will demonstrate that working in financial accounting (FI) and management accounting (CO) is much more than just getting the right numbers; it's about building trust around the numbers, both within the organization and beyond.

The task of condensing finance as a disciple down into the next two chapters isn't a simple one, and this chapter is neither designed to be comprehensive nor does it go into the minutia of any specific facet. Rather, it's intended to provide a flavor of the important aspects of finance and the key tools within the SAP landscape that enables them.

Finance is split into two principal areas: FI and CO. We'll discuss CO in Chapter 10; in this chapter, we'll focus on FI.

FI involves recording financial transactions, and summarizing, analyzing, and producing the financial statements over a specific period of time, which is consumed mainly by people external to a business, such as government and shareholders. Typical processes in this area involve the closing of the financial period as reporting is generated off the back of this process. Prior to this, the traditional subledgers of accounts payable (AP), accounts receivable (AR), and asset accounting (AA) are closed, and the transactions and balances created in the General Ledger (G/L) are analyzed and amended if necessary. Furthermore, there is the importance of SAP Treasury and Risk Management to ensure that an organization can meet its financial obligations in terms of management of activities, such as cash, payments, liquidity, risk, and compliance.

Out with the Old

Traditionally, SAP R/3 has supported finance within the area of Financial Accounting (FI) delivered through classic G/L, Special Purpose Ledger (FI-SL), Fixed Assets, and Material Ledger (ML) modules. Similarly, CO had been delivered through Profit Center Accounting (PCA), Profitability Analysis (CO-PA), Product Costing, and Controlling modules. With the introduction of SAP ERP, this presented the concept of the New G/L, where the lines between FI and CO were narrowed as PCA now formed part of FI.

Traditional financial reporting has therefore suffered and relied on different views using tools outside of the core system, such as SAP Business Planning and Consolidation (SAP BPC) to report, for example, legal entity accounts, cost by responsible area and profitability by segment. So, what's new you ask? SAP has taken the best of the old world (e.g., ledgers, market segments) and consolidated this information into one, providing the ability to report real-time multidimensional financial information in theory. The line between FI and CO is now completely blurred, through the concept of "principle of one" and the Universal Journal, which we'll explain further in this chapter.

Today, the finance functionality is contained within SAP S/4HANA. Previously, this was called SAP Simple Finance, which was then converted to SAP S/4HANA Finance. SAP S/4HANA Finance isn't a separate solution from SAP S/4HANA; rather, it more specifically refers to the finance functionality. In this chapter (and Chapter 10), we'll be referring simply to SAP S/4HANA.

In short, finance is an area that can be confusing to many people. Debits, credits, amortization, depreciation, T-accounts, and many other seemingly nebulous terms and processes make this topic appear inaccessible to the nonfinance professional. As

an antidote to this, this chapter is written not only for the accountant but also for the rest of us who don't understand why we're not allowed to talk to the finance department at any point around period end!

This chapter is split into individual sections that first introduce a topic from a business process perspective before introducing some of the SAP products that facilitate it; particularly, SAP S/4HANA.

9.1 Business Case

Like all global corporations, Bault Robotical employs many people within its financial function. All upstream processes eventually end up in finance as a transaction, requiring to be reported as part of the organization's financial statement. In earlier chapters, we've demonstrated how Bault Robotical has acquired stock and procured nonstock items from its suppliers; it would have also received and fulfilled orders from its customers across the globe, with expectation of payments on outstanding invoices. (It would also be paying its staff via SAP SuccessFactors Employee Central Payroll, a process that we'll discuss further in Chapter 12.) As part of the period end, the finance team will be required to consolidate all this financial information and prepare reports detailing its financial position.

Bault Robotical is also facing the following challenges in its finance landscape:

- Bault Robotical has a problem with high days sales outstanding (DSO), which is the number of days it takes for the company to collect receivables in one of its regions. It needs better visibility on liquidity and the ability to manage its overall working capital. We'll discuss this further in Section 9.5.
- In its UK market, Bault Robotical needs to ensure it's compliant with the latest financial reporting standards introduced from January 1, 2018, around its revenue recognition and treatment of leases (International Financial Reporting Standards (IFRS) 15 and IFRS I6, respectively). It needs to ensure compliance with different performance obligation and revenue recognition types associated with its customer contracts. We'll discuss this further in Section 9.8.
- Furthermore, Bault Robotical needs to ensure that it accounts for both its financial and operational lease to enable the users of its financial statement to assess the impact of their organization's leases on the financial position and cash flow directly from its balance sheet We'll discuss this further in Section 9.8 and Section 9.11.

We'll now demonstrate how the set of financial operating activities are run by Bault Robotical finance practitioners. We'll reveal the key financial accounts reported as part of period end and demonstrate how the SAP Financial Closing cockpit for SAP S/4HANA provides support by generating such reports. We'll also explore key FI concepts and models (receivables management, including SAP Financial Supply Chain Management [SAP FSCM]; invoice management and AP; AA; Flexible Real Estate Management [RE-FX]; SAP Treasury Management; governance, risk, and compliance [GRC]; and access controls/process controls) that ultimately impact the G/L and what is reported.

9.2 Financial Statements

To many of you reading this chapter, the title alone may have been enough to make you reach for a cup of coffee and consider skipping this chapter altogether. However, before you do, consider that FI is one of the simplest concepts to understand in this entire book. While its execution requires years of training, understanding what it is and what it's designed to achieve certainly doesn't.

The goal of financial accounting is to create the following financial statements:

- Income statement
- Balance sheet statement
- Cash flow statement

Together the three financial statements provide a formal record of the position of a business (on a certain date), plus a financial summary of how an organization performed in the previous 12 months. US business collate this information in accordance with Generally Accepted Accounting Principles (GAAP), and international public businesses collate their information by International Financial Reporting Standards (IFRS). The purpose of these principles and standards is so that companies provide consistent and easily digested information to creditors, regulators, and tax authorities.

All other activities and terms such as the chart of accounts, the G/L, accounts, journals, and journal entries are included to support the creation of one or more of these reports. So, feel free to grab that coffee, but please stick with us as we discuss financial statements in a little more detail.

9.2.1 Income Statement/Profit and Loss

The income statement, which is also known as the profit and loss (P&L) statement or statement of revenue and expense, covers a specific time frame such as a year for annual financial statements and three months for quarterly financial statements. Together with the information specific to the period of time that is being reported, the financial statement generally contains two or three other periods for comparison.

The income statement contains the following information:

- **Revenue**
  The first line on the income statement is sales revenue, which is the sum of the income received from customers from the sale of goods or provision of services.
- **Cost of goods sold (COGS)**
  The second line on the income statement is cost of goods sold (COGS). COGS records the direct costs associated with the production of goods or provision of services. A direct cost (as opposed to an indirect cost) is a cost that can be attributed specifically to the production of specific goods or service. Examples of direct costs include material costs (e.g., when component materials are consumed) and direct labor costs (e.g., workers on a production line).
- **Gross profit (or gross margin)**
  Gross profit is simply the revenue minus the COGS. A company's gross profit is its profit before operating expenses, interest payments, and taxes.
- **Operating expenses (or overhead expenses)**
  These are costs that, unlike direct costs, can't be directly associated with production or the provision of a service. In a typical business, operating expenses would include items such as bonuses, payroll, employee benefits and pensions, travel, rent, depreciation (the decrease in the value of tangible assets, e.g., computers), and amortization (the decrease in value of an intangible asset, e.g., patents and intellectual property).
- **Earnings before interest and taxes (EBIT), operating earnings, operating profit, and profit before interest and taxes (PBIT)**
  This is a simple calculation where all expenses, including COGS, are subtracted from the total revenue.
- **Interest expense**
  This represents any interest payable on borrowings.

- **Taxes**
  This is the income tax expense that relates to the revenues and expenses shown earlier on the income statement. The income tax amount hasn't actually yet been paid but represents an estimation of what the company expects to pay.
- **Net income (net profit or net earnings)**
  This is the main indicator of the company's profitability—the bottom line. It represents a company's revenue minus COGS, expenses, and taxes for the accounting period of the income statement. If the total revenue is greater than the total expense, then the company has made a profit; conversely, if the total expenses exceed the revenue, then the company has a loss.

These calculations are now demonstrated in a simplified income sheet shown in Figure 9.1.

Simplified Income Statement for Year Ending 31st December 20YY		
Total Revenue	20,000,000.00	
Cost of goods sold (COGS)	10,000,000.00	
Gross Profit		10,000,000.00
Operating Expense		
Selling Expense	4,000,220.00	
General & Administrative Expense	1,999,780.00	
Total Operating Expenses		6,000,000.00
Operating Profit before Tax		4,000,000.00
Financial Revenue & Expenses		200,000.00
Earnings Before Interest & Tax		3,800,000.00
Taxes		760,000.00
Net Income (Profit)		**3,040,000.00**

Figure 9.1 Simplified Income Statement

9.2.2 Balance Sheet

The balance sheet, unlike the income statement, is a snapshot of assets, liabilities, and stockholders' equity of a company at a specific point in time, which is generally the end of the fiscal year. (A fiscal year is a specific period that a company or government uses for accounting purposes and the preparing of financial statements; it's not necessarily the same as a calendar year.)

The calculations are now demonstrated in a simplified balance sheet shown in Figure 9.2.

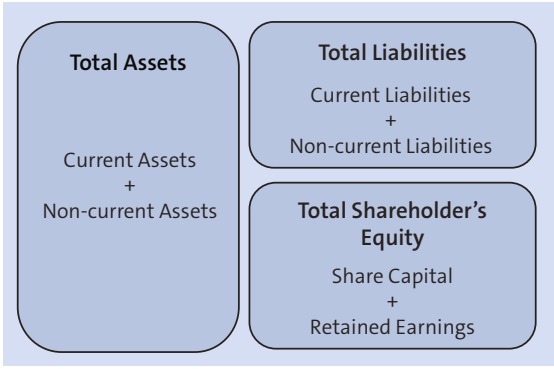

Figure 9.2 A Simple Balance Sheet (Assets = Liabilities + Shareholders' Equity)

The logic behind the balance sheet is fairly intuitive; the company has to pay for the things it owns (assets), and this can either be done by borrowing money (liabilities) or through investment (issuing shareholders' equity). Assets, liabilities, and shareholders' equity are each made up of smaller accounts that break down the specifics of a company's finances.

We'll briefly discuss assets, liabilities, and stockholders' equity in a little more detail here:

- **Assets**
  The assets section of the balance sheet is ordered on the basis of liquidity (the ease by which they can be converted to cash). It's also split into current assets (defined as things that are likely to be converted into cash within one year) and noncurrent assets that can't be converted.

  The following outlines a simplified list of current assets:

  – Cash and cash equivalents: Cash needs little explanation and will appear first on the balance sheet. Cash equivalents can be thought of as short-term investments that have high credit quality and can be liquidated on short notice (easily turned into cash).

  – Accounts receivable (AR): This represents the sum of "good" sales revenue that remains on credit. This should not include doubtful accounts.

- Inventory: This reflects the value of the raw material, work in progress (WIP), and finished stock.

The following represents examples of noncurrent (fixed) assets:

- Plant, property, and equipment (PP&E): This includes the company's tangible assets, such as machines, plant, and property. The figure outlined here is net of depreciation, meaning that the figure includes considers depreciation. The nature of the business will dramatically affect the PP&E balance; for example, a construction company or heavy manufacturer will have a significantly higher PP&E balance than a consultancy or accountancy.
- Intangible assets: This line item includes a company's identifiable assets, such as patents and licenses, along with unidentifiable assets, such as goodwill and brand value.

- **Liabilities**

  In common with assets, liabilities are also categorized as current or noncurrent. Current liabilities represent amounts due to be paid to creditors within the next 12 months, whereas noncurrent liabilities are longer-term liabilities that will not come due in less than 12 months.

  Current liabilities include the following:

  - Accounts payable (AP): This is the amount that the company owes to suppliers of materials or services procured on credit. When a company pays off the debt, then AP decreases as will the amount shown as cash.
  - Current debt/notes payable: This represent debt obligations that are payable within the next 12 months; it doesn't include AP obligations.
  - Noncurrent liabilities: An example of a noncurrent liability is long-term debt (excluding any amount to be paid off in the next 12 months).

- **Shareholders' equity**

  The owners' equity can be considered to be the source of the company's assets, sometimes referred to as the book value of the company. The owners' equity is equal to the reported asset amount less the reported liabilities amounts. Shareholders' equity will contain the following:

  - Share capital: This represents the value of the funds that the shareholders have invested into the company.
  - Retained earnings: This is the total amount of net income that the company decides to keep after dividends have been paid out.

9.2.3 Cash Flow Statement

The final of the three financial statements in financial accounting is the cash flow statement or statement of cash flows. The cash flow statement shows how much cash has been generated and spent during a specific time period and is categorized into the following:

- **Operating activities**
  Cash flow from operating activities indicates the amount of money that a company receives and spends during its regular business activities, such as manufacturing and selling goods or providing services.

  Operating activities include the following:
  - Receipts from sales of goods and services
  - Payments made to suppliers of goods and services used in production
  - Salary and wage payments to employees
  - Rent payments
  - Interest payments
  - Income tax payment
- **Investing activities**
  The investment activities report the purchase and sale of long-term investments, property, plant, and equipment.
- **Financing activities**
  Cash that falls into this bucket is "cash in" when capital is raised (e.g., when a company issues a bond to the public; a bond can be thought of as a loan between an investor and a corporation). As well as cash in comes "cash out," which is when the company pays out cash, such as the issuing of dividends.

Figure 9.3 is an example of a simple(ish!) cash flow statement.

We now have the output required from financial accounting. Next let's work backward to understand how, when, and from where this information comes.

Cash Flow Statement			
For the Year Ending	31/12/2015	31/12/2017	31/12/2017
Cash at begninning of year	£ 15,000.00	£ 35,000.00	£ 56,000.00
Cash at the end of the Year	£ 35,000.00	£ 56,000.00	£ 80,000.00
	2015	2016	2017
Operations			
Cash Receipts from:			
Customers	£690,000.00	£760,000.00	£838,000.00
Other Operations			
Cash Paid for			
Inventory Purchases	-£260,000.00	-£290,000.00	-£319,000.00
General operating and admin expenses	-£112,000.00	-£123,000.00	-£135,000.00
Wages expenses	-£123,000.00	-£135,000.00	-£148,000.00
Interest	-£ 13,000.00	-£ 14,850.00	-£ 16,000.00
Income Taxes	-£ 32,000.00	-£ 36,000.00	-£ 39,000.00
Net Cash Flow from Operations	£150,000.00	£161,150.00	£181,000.00
Investing Activities			
Cash Receipts from:			
Sales of property and equipment	£ 33,000.00	£ 36,000.00	£ 40,000.00
Collection of loans			
Sales of securities			
Cash Paid for			
Purchase of Property and equipment	-£ 75,000.00	-£ 82,000.00	-£ 90,000.00
Loans and other entities			
Purchase of Investment Securites			
Net Cash Flow from Investing Activites	-£ 42,000.00	-£ 46,000.00	-£ 50,000.00
Financing Activities			
Cash Receipts from:			
Issuance of stock			
borrowing			
Cash Paid for			
Repayments of loans	-£ 34,000.00	-£ 37,000.00	-£ 41,000.00
Dividends	-£ 53,000.00	-£ 58,000.00	-£ 64,000.00
Net Cash Flow from Investing Activites	-£ 87,000.00	-£ 95,000.00	-£105,000.00
Net Cash Flow	£ 21,000.00	£ 20,150.00	£ 26,000.00

Figure 9.3 Sample Cash Flow Statement

9.3 General Ledger Accounting

Let's look at another key concept of FI: the General Ledger (G/L). The G/L is part of G/L accounting and is an organization's system of records. It basically records all the

deposits into and withdrawals out of each G/L account together with an ending balance, as shown in our example in Figure 9.4.

Account		
0110 Cash		
	Deposit	100.00
	Withdrawal	- 50.00
	Receipt	200.00
		250.00

Figure 9.4 G/L Account

All of the accounts listed this way are called the G/L. You create a ledger for each of the G/Ls you need to report on. For those of you familiar with the classic G/L, this concept is similar to the Special Purpose Ledger (FI-SL) where you could create a user-defined special ledger as a general or subsidiary ledger for reporting. In SAP S/4HANA, this functionality is really now redundant with the leading and nonleading ledgers, although SAP hasn't disabled this feature. The ledger is a key dimension within the Universal Journal (which we'll discuss further in Section 9.3.3) with SAP providing the following four types of ledgers in SAP S/4HANA:

- **Leading ledger**
  The leading ledger is the main ledger in FI to which you assign your company codes. It contains the full set of accounts and is linked to the leading financial standard to which your organization's accounts are prepared, subject to localization requirements. For example, a US company will define its leading ledger to support financial statement reporting based on US GAAP principles.
- **Nonleading ledgers**
  This concept isn't new with SAP S/4HANA but was introduced as an alternative to G/L account-based parallel valuation with the new G/L. The nonleading ledgers provide a parallel complete set of books to the leading ledger. Simply put, this is another set of books that you maintain in parallel to the main set of books. These books (parallel ledgers) are based on a different set of accounting principles adopting local accounting treatments, such as Spanish or German GAAP.

  We can consider our business case as an example. Bault Robotical operates as a global company and needs to report and consolidate its financial records according to IFRS where it's registered in the United Kingdom and across Europe. It also needs to report based on US GAAP due to its American arm of the business. To achieve this in the system, it adopts two parallel ledgers with the leading ledger

based on IFRS and the nonleading ledger based on US GAAP accounting principles for the US company.

The ledger approach to parallel valuation using the nonleading ledger provides businesses with additional flexibility as this can be activated on an individual company code basis. It also provides greater controls around managing closing operations because postings to the nonleading ledger can be managed independently based on having its own defined fiscal year and posting period variants.

- **Extension ledgers**
  A new concept introduced as part of SAP S/4HANA is the extension ledger. It's created as an add-on to an underlying ledger (leading or nonleading). Any postings made to the underlying ledger also apply to the extension ledger. When a report is run for an extension ledger, the data of the underlying ledger is also called.

  In practical terms, the extension ledger can be used in specific scenarios where minor adjustments don't need to be reflected in the leading ledger as posted, for example, to support specific management adjustments. It therefore supports manual postings made in the extension ledger (automatic postings aren't possible).
- **Day ledger**
  The final type of ledger is your day ledger used to create reports for average balances (reports for displaying average daily balances). This ledger is less frequently used by customers.

The inherent nature of the G/L provides for data consistency in FI via a single data source (Universal Journal). The integration of all financial postings (revenue, cost, balance sheet) across different processes provides greater internal control and provides a single source of truth for reporting. The following key components integrate to the G/L:

- Asset accounting (FI-AA)
- Accounts receivable and accounts payable (FI-AP/AR)
- Controlling (CO)
- Materials management (MM)
- Human capital management (HCM)
- Treasury and risk management (TRM)
- Travel management (FI-TV)
- Expense management (SAP Concur)

Having discussed what the G/L is and how the information contained within forms the basis of financial reporting, we need to tackle the question of how the information is populated.

9.3.1 Chart of Accounts

If you look at the three financial reports just discussed, you'll see that in total, there are only five account groups in the chart of accounts:

- Assets: What you own
- Liabilities: What you owe
- Equity: Investment in the company
- Revenue: Income earned
- Expenses: Bills you pay

Under each of these five account groups will be additional lower-level accounts that provide greater granularity. A full list of these accounts is called the chart of accounts.

In SAP S/4HANA, the chart of accounts consists of a list of G/L accounts used by one or several company codes within an organization. Within an organization, you must have a minimum of one chart of accounts, called the operating chart of accounts, which contains the G/L accounts used for posting the organization's daily activities.

In addition to the operating chart of accounts, you can use two additional charts of accounts. This includes the group chart of accounts containing the G/L accounts used by the entire corporate group, making it possible to provide financial statements and reports for the entire group. Another optional chart is the country-specific chart of accounts, which contains specific G/L accounts needed to meet the country's legal requirements. This is defined in conjunction with the operational chart and allows the organization to provide statements for its country's legal requirements, such as tax reporting.

To consider an example, Bault Robotical as a global organization adopts both an operational and a group chart of accounts. The operational chart of accounts is shared both in FI and CO.

As part of the chart of account structure, the G/L account master in SAP S/4HANA is structured into three principal areas:

- G/L account master in the chart of accounts
- G/L account master in the company code
- G/L account master in the controlling area

All transactions are recorded against one of the accounts in the chart of accounts; everything that a business does is recorded cumulatively against one of these accounts.

9.3.2 Journal Entries

A journal is a record of financial transactions ordered chronologically. A journal entry is made when a financial transaction occurs. The journal entry details the transaction within the journal, and it's usually recorded using a double entry method, ensuring that all journals must balance to zero.

We've now arrived at the start of the process—the transaction. A financial transaction is an agreement between a buyer and seller to exchange goods or services. Within SAP, certain transactions equate to financial transactions. For example, the creations of a purchase order (PO) won't create a journal entry, but the receipt of a PO will; similarly the creation of a sales order won't trigger a journal, but the goods issue of a sales order will.

You can post to G/L accounts either manually or by uploading a file containing journal entries. In addition, journals are triggered automatically where the G/L accounts are assigned for automatic posting of the business transactions. All journal entries result in the creation of an accounting document that provides a date and time stamp of the business transaction entered in the ledger.

As explained earlier, not all journal entries originate from the G/L. In SAP S/4HANA, FI journal entries are also triggered by business transactions in other areas such as SD and MM. To enable business transactions to trigger FI journal entry postings automatically, you'll need to configure the system and identify target accounts for automatic postings. Examples of some of these settings needed to make the system work as an integrated component and seamlessly include the following:

- **MM–procurement process**
  The procurement process involves COGS or services received to be paid by your organization. Every time a procurement process occurs, the cost must be entered to the correct G/L account, making it impractical to remember the G/L account each time. So, to integrate the purchase process with the G/L, you can make configurations for transactions in inventory management and invoice verification so FI journal entries post automatically. For those companies that choose to implement

the ML with SAP S/4HANA, the simplified data model with the Universal Journal reduces the need for reconciliation as existed with the classic ML in SAP ERP.

- **SD–sales process**
  You can define how to post FI documents to G/L accounts from SD by configuring account determination for transactions in revenue, reconciliation, cash, and payment cards. Revenue account determination is integrated between SD and the G/L, which is achieved using what is called the "condition technique" to allocate the correct G/L account based on a pricing procedure.
- **SAP SuccessFactors Employee Central Payroll process**
  Similarly, you can make settings to define how to post FI documents to G/L accounts from payroll by configuring account determination for wage type and symbolic accounts transactions. The account determination settings enable the automatic posting of some of the following payroll postings:
  - HR postings, financial accounts
  - HR postings, expense accounts
  - HR postings, technical accounts
  - HR customer accounts
  - HR supplier accounts

  We'll discuss SAP SuccessFactors Employee Central Payroll further in Chapter 11.
- **FI determination**
  The AA component of FI is used for managing and supervising fixed assets with the SAP system. In FI, it serves as a subsidiary ledger to the G/L, providing detailed information on transactions involving fixed assets as discussed further in section Section 9.7. To support the automatic postings to the G/L, the account determination is defined for all asset balance sheets and P&L depreciation accounts to reflect that all accounting transactions posted to assets are also updated in the G/L. Other accounts that can be posted automatically include exchange rate differences, retained earnings, reclassification of AP and AR balances according to their maturity, and bank statement account postings.

9.3.3 SAP S/4HANA Finance

SAP S/4HANA serves the requirements of both internal and external stakeholders. Organizations such as Bault Robotical need an accurate record of the past, direct insight into the present, and a clear view of the future. SAP S/4HANA comes with

optimized financial accounting processes and supports the operational finance experts driving efficiency and compliance.

SAP S/4HANA and G/L accounting provide the basis of all finance reporting. All business processes generating a financial transaction will flow into FI in SAP S/4HANA. As such, the business will manage and execute its period end and year end in the system. It will hold a single version of the truth (enabled by table ACDOCA—Universal Journal table).

SAP S/4HANA contains the following features and functionalities for FI:

- **Universal Journal**
  For those finance consultants who have experience with SAP ERP Financials, this represents possibly the biggest advantage of SAP S/4HANA over SAP ERP. In a nutshell, the Universal Journal brings together once separate components of FI and CO, which is described later in this chapter through a simplified data model. In practice from a technical standpoint, the Universal Journal combines the most important fields from both a FI and CO perspective into a single table (table ACDOCA).

  The Universal Journal is a very large table with more than 350 dimensions that consolidates financial, controlling, and profitability segment information. For example, it contains company codes, G/L accounts, cost elements, cost centers, vendors, assets, and profitability segments (e.g., customers, products, and regions). This provides for flexibility in reporting as you can slice and dice the information in real time using embedded analytics (which we'll discuss further in Chapter 15).
- **Line item-based journal processing**
  Another major feature of SAP S/4HANA is the processing and analysis of data based on line items rather than preconfigured totals, so that you can achieve the highest level of granularity available for reporting. From a technical standpoint, you don't have to set up aggregates before evaluating the data, which limits the type of analysis you can do and the speed of the analysis. With SAP HANA, you can perform your analysis quickly in the operating system without the need to replicate the data in a special SAP Business Warehouse (SAP BW) system.
- **Use of the extension ledgers (account based vs. ledger based)**
  In new G/L accounting, different accounting principles can (still) be mapped using the accounts approach. In addition to accounts, however, the new G/L also allows you to use different ledgers to save the different valuation approaches; this is

called the ledger approach as discussed earlier. Figure 9.5 demonstrates how the extension ledger can be applied in practice.

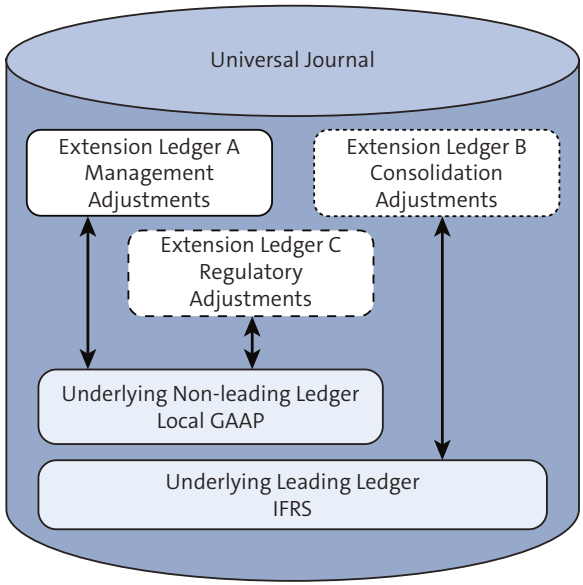

Figure 9.5 Universal Journal: Ledger Approach

- **Master data cost elements and G/Ls**
  In the classic SAP ERP data model, an account consists of charts of accounts data (table SKA1), company code-specific data (table SKB1), and the account's description (table SKAT). If an account is relevant for CO, a cost element (primary cost or revenue element) must be generated. Secondary cost elements exist only in CO, so only the CSK* tables are updated. In the new SAP S/4HANA data model, only one master record is needed, which is the account providing data simplification. A new field is added (GLACCOUNT_TYPE) to differentiate between the different G/L account types.

9.4 Financial Close

The accounting and financial close is also known as "closing the books." At the end of a financial period, usually based on a month-, quarter-, or year-end, it's the responsibility of the finance function to deliver external and internal financial information (internal to parent companies or directors, and external to authorities or regulators).

This process is very time-sensitive and has key dependencies on upstream processes such as procurement (Chapter 4) or sales (Chapter 2). Late submission of financial reports can result in penalties, and, if internal, it can impact the ability of the business to make key decisions.

The purpose of the close is basically to ensure that everything which should be included in the financial period being closed has been included and is accurate. There are four procedures we'll discuss pertaining to the end-of-month close, as follows:

1. **Financial adjustments**
   The first step in the end-of-month accounting process is to address the needs for financial adjustments. To create a complete view of the organization, journals need to be entered for things such as accrued expenses (expense) and the write off of receivables (income), for example, in the case of a bad debt. There are two types of entries:
   - **Income entries**
     On the income side, examples of journal entries include reclassification entries (a journal entry that transfers an amount from one G/L account to another), writing off receivables (e.g., in the case of a bad debt), reconciliation entries (where the accounting entries differ from the bank account), and monthly utility incomes.
   - **Expense entries**
     On the expense side, entries may include expense accruals, which is a journal entry that allows a company to include expenses in the period they were incurred, even if they haven't yet been paid for, for example, where invoices haven't yet been received from a vendor. These entries may also include amortization and depreciation.
2. **Calculating balances**
   The calculation of balances is as the name suggests the calculation of the position at the end of the period. Each account is examined, and the balance is calculated. The closing balance is the amount of cash on the last day of the month. The closing balance is a simple calculation (Opening Balance + Total Income – Total Expenditure). The final number is the current value of the organization's net worth. It's also the opening balance of the following month.

   The closing balance is the amount of cash on the last day of the month. The closing balance is a simple calculation as well (Opening Balance + Total Income – Total Expenditure).

3. **Opening and closing posting periods**
   At the end of each period, the process of advancing from one month or period to the next or from one year to the next is referred to as closing. By moving to the next month, through the opening and closing of periods, you make sure that journal entries are posted to proper posting periods. This is to ensure that posting transactions continue to be made to the ledger.
4. **Monthly reporting**
   The monthly reports are the internal and external reports that need to be submitted by finance and that show the company's current financial position. These are obviously based on the transactions produced throughout the months and are cleaned up as part of the earlier month close activities.

To successfully perform financial close, you can use the SAP Financial Closing cockpit for SAP S/4HANA. The features and functions within G/L accounting allow you to perform your period-end closing in a timely manner. SAP Financial Closing cockpit for SAP S/4HANA provides a robust graphical application designed for the purpose of standardizing the closing cycle and gives the finance function greater control over the entire closing process.

SAP Financial Closing cockpit for SAP S/4HANA now forms a core part of the latest release of SAP S/4HANA (as opposed to an add-on in earlier versions). You can therefore benefit from the ability of the feature supporting your closing operations through the following:

- **Define global plans for close**
  The corporate departments define the templates containing all default tasks relating to close.
- **Prepare entity close**
  You can leverage best practice templates to create local or global closing templates, containing all task lists for a closing cycle.
- **Execute entity closing tasks**
  This includes manual tasks (notes), transactional, programs, workflows and and jobs/remote tasks, taking into account any task dependencies.
- **Monitor and analyze closing tasks**
  You can track the status and progress of the organization's close at all levels of responsibility.

As part of the financial closing operation in SAP S/4HANA, you can display financial statements by displaying the balance sheets and P&L. It's also possible to download

financial statements to a PDF and Microsoft Excel using the Financial Statement – Grid-Based app and use other additional functions, as most accountants can't work without Excel.

A new capability of SAP S/4HANA, embedded analytics, enables you to create financial statement-based key performance indicators (KPIs) within SAP Smart Business. Examples of supported KPIs include working capital; earnings before interest, taxes, depreciation, and amortization (EBITDA), and financial statement-based measures.

9.5 Receivables Management

The receivables management process is concerned with relationships an organization has with its customers and the collection of monies owed to the business as a result of transactions between both parties. It essentially encompasses all the activities in the credit-to-cash cycle. Good receivables management supports timely payment and reduces overdue payments.

We can break down this cycle into the following five main areas:

- **Customer acquisition (assessing credit worthiness)**
  Unlike interactions with consumers where payment is generally taken prior to the shipment of goods, in a business context, goods are generally produced and shipped prior to receiving funds. Set against this context, ensuring that the customer is worthy of this trust is paramount. Therefore, the first job of receivables management is to determine the risk/reward of extending credit terms to potential clients. Practically, this may involve asking for credit references and identifying credit ratings and scores (such as those produced by Dun & Bradstreet). Checks should continue to be carried out on existing customers to get early warning of any problems that may be developing.
- **Billing and AR management**
  The next part in the process is the billing itself. A good receivables management function will be effective in the management of billing. Invoices should be sent in a timely manner and be accurate and professional in appearance. The receivables management function may also include customer service centers that handle and resolve the billing inquiries of customers.

  To support the cash collection process, the customer must be invoiced in line with their payment terms. It's essential that the customer invoice must be sent out accurately and quickly.

AR should be monitored continuously to ensure the customer is keeping up with his debt. There are a number of key reports that support this monitoring process:

- Age debt report analysis: This shows the amount outstanding for each customer over a period of time.
- Credit utilization report: This shows the proportion of customer credit limit that has been used.
- Exposure monitoring report: Taking into account the customer outstanding debt and level of credit usage, this shows how exposed an organization is to its AR.

- **Cash collection**
  Cash collection is the process of receiving cash from customers based on the settlement of their invoice. The AR management department seeks to collect outstanding debt based on the payment method agreed on with the customer. This could include direct debit, Single Euro Payments Area (SEPA), debit, cash, check, and card payments to name a few.

  Having sent out the invoice in a timely manner, an organization can adopt different methods to ensure its customers pay in a timely fashion:

  - Customer statements
  - Chasing letters
  - Chasing phone calls
  - Stopping supplies
  - Legal action
  - Selling the debt (factoring)
  - External debt collection agency

- **Delinquency management**
  Dealing with delinquent accounts is an activity that can consume a considerable proportion of the overall effort of a receivables management function. Successful delinquency management involves defining strategies for collecting the balance of these unpaid monies with the need to maintain customer relationships.

- **Recovery**
  If the account remains delinquent, typically for a period of 180 days or 6 months, the debt is considered charged-off, which means that it's deemed unlikely to be collected, and typically the debt will pass to a third party to recover the cash.

Receivables management has been developed to harness the benefits of SAP S/4HANA by monitoring receivables and payments in real time. As we discussed, effective receivables management is dependent on risk awareness. Cash is and remains "king" of any business, and receivables in addition to payables are at the center of this.

To support this cycle, SAP offers an array of solutions. SAP S/4HANA Finance for Receivables Management contains the following features and functionalities:

- **AR accounting**
  The AR accounting functionality allows you to manage open invoices and incoming payments, as well as to monitor and follow up on overdue receivables. This functionality enables the AR department to process incoming payments with electronic or manual bank statements.

  A key component of the AR function is the ability to monitor receivables. SAP S/4HANA delivers analytical overview applications that display KPIs such as the following:

  - AR aging analysis: Displays a chart of overdue and future receivables separated by age.
  - DSO: Displays your average DSO in days and a chart that shows your actual DSO against your best possible DSO. As shown in our business case, Bault Robotical can run its DSO analysis to identify its delinquent customers and identify a strategy on how best to manage such customer debt.
  - Top 10 debtors: By identifying your most valuable customers, this can assist the AR function in managing its relationship with its customer business partners.
- **SAP Cash Application**
  This is a new SAP product harnessing the power of machine learning. Traditionally, the matching of payments and invoices is a time-consuming exercise because it's often difficult to match items (often due to bulk payments for multiple items or poor reference information). This product offers a cloud-based matching engine to automate and simplify incoming bank statement and cash allocation processing using machine learning intelligence.

Digital Disrupter

SAP Leonardo machine learning as a digital disrupter can assist organizations to raise productivity, increase profitability, reimagine processes, and enrich their customers' experience. It offers the next frontier of ERP through enabling an intelligent enterprise.

From a machine learning perspective, the tool learns from historic records of successfully cleared receipt items or from the actions of the clerk based on specific customer or country behaviors. It then creates a machine learning proposal of items to be matched. Based on the level of matching confidence, you can choose to post in line with the machine learning proposal and then subsequently clear outstanding open items.

- **SAP Credit Management**
  Most organizations like to manage their credit risk with their customers, and SAP Credit Management provides this capability. It provides full integration with AR, SD, and other third-party credit scoring agencies, such as Standard & Poor's.

  SAP Credit Management provides functionality to integrate external credit information, scoring, categorizing new and existing customers based on their credit data, and converting this information into quick credit decisions. SAP Credit Management allows organizations to manage, monitor, and control their customer's credit risks. With SAP Credit Management, you can manage centrally all credit limit and credit decision associated with the customer business partner.
- **SAP S/4HANA Cloud for credit integration**
  Management of risk associated with customers is highly important. This SAP product facilitates the integration between third-party credit agencies and SAP S/4HANA (as shown in Figure 9.6). This then contributes toward the credit score applied to customers and the basis of the commercial relationship going forward.

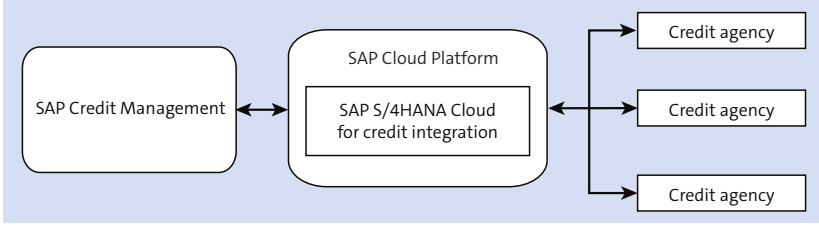

Figure 9.6 SAP S/4HANA Cloud for Credit Integration

SAP S/4HANA Cloud for credit integration extracts information from credit reports that are provided by the credit agencies and automatically updates organizational and credit data into your SAP Credit Management system.

- **SAP Collections and Dispute Management**
  Again, as part of receivables management in SAP S/4HANA, SAP Collections and

Dispute Management provides the functionality to actively manage customer business partner receivables. SAP Collections and Dispute Management uses worklists based on customizable collection strategies to drive collection specialists' work activity.

Using collections strategies, you can valuate and prioritize customers from a receivables management view. Collection specialists are able to create and track customer contacts, raise customer dispute cases, and manage resubmissions and promises to pay.

SAP Collections and Dispute Management supports the process of recording, processing, escalating, and resolving disputes relating to customer invoice queries managed through the dispute case. It's also fully integrated with AR.

- **SAP S/4HANA Cloud for customer payments**
  This product is an application for matching customer payments with invoices. The aim of the product is to support cash flow management by simplifying the processing of electronic payments from customers. It enables your customers to view invoices, bills, and statements, as well as to make payments. They can also raise and manage customer dispute cases via this process.

  The system landscape for SAP S/4HANA Cloud for customer payments consists of the following two main areas:

  – In your on-premise system landscape, you need to install cloud connector and connect it to your SAP backend system.
  – On the SAP Cloud Platform, a dedicated consumer account is allocated to you.

9.6 Invoice Management and Accounts Payable

At the opposite end of the spectrum to receivables management is invoice and AP management. In the previous section, we outlined how we, as a customer, will ship a product prior to money being exchanged. Indeed, we would issue an invoice and collect payment later. The AP function is the control of this same process but with the roles reversed; this time, rather than being the customer, we're the vendor, meaning that we've received goods or services but haven't yet paid for them.

To safeguard an organization's cashflow, the AP process has great controls that do the following:

- Prevent paying a supplier twice (duplicate invoice).
- Prevent paying a fraudulent invoice.

- Prevent paying an inaccurate invoice.
- Ensure all invoice payments are correctly accounted for.

A simplified flow for the invoice management process is as follows:

1. **Receiving invoice**
   The starting point for the AP process is when an invoice or bill is received. It may be received in a myriad of formats and communication may come in a variety of ways, such as digitally, paper, email, or fax. When the invoice is received, it's referred to as a customer invoice.
2. **Matching and approval**
   A fundamental question that the AP function needs to answer is simple: Is the money demanded actually owed? Answering this question generally involves three-way matching by cross-referencing three documents:
   - PO: What did we order?
   - Goods receipt: What did we receive?
   - Customer invoice: What are we being asked to pay for?

   If all three documents contain the same information (quantities and prices), then the invoice is verified and approved. If, however, there are any discrepancies, then payment is withheld until the issue is investigated and rectified.
3. **Authorize and send payment**
   The next step is for the AP function to review all invoices that are due for payment based on the payment terms and check and authorize the invoice for payment. After the payments have been checked and verified, they can then be passed on to the bank for payment to the supplier.

AP offers several different solutions to support invoice management and AP. Some of them are new, and the products are aimed at different customers. They are also at different levels of maturity with not all of them currently integrating with SAP S/4HANA.

Let's explore the key solutions offered by SAP, as follows:

- **SAP Invoice Management by OpenText**
  This solution can be deployed on-premise or in the cloud and supports invoice spend type, invoice automation, invoice conversion services (paper to digital), workflow, invoice matching, contract and service invoicing, compliance checks, and automated payments. It's designed for medium and large enterprises and integrates with SAP S/4HANA.

- **SAP Ariba Invoice Management**
  This solution can be deployed on-premise or in the cloud and supports invoice spend type, invoice automation, invoice conversion services (paper to digital), workflow, invoice matching, contract and service invoicing, compliance checks, automated onboarding, and supplier network collaboration. It's designed for large enterprises and integrates with SAP S/4HANA.
- **SAP Ariba Payables**
  This solution can be deployed on-premise or in the cloud and supports invoice spend type, invoice automation, invoice conversion services (paper to digital), workflow, automated payments, dynamic discounting, supply chain finance, business-to-business (B2B) payment capabilities, automated onboarding, and supplier network collaboration. It's designed for large enterprises and integrates with SAP S/4HANA.
- **SAP Multibank Connectivity**
  Extend and innovate your payment processes by rapidly integrating SAP S/4HANA with SAP Bank Communications Management network and SAP Multibank Connectivity. Simplify and secure connectivity to enable transactions with multiple financial institutions. The solution provides a single integration point to automate incoming and outgoing payment transactions, instead of multiple point-to-point technologies for each partner bank. It provides the ability to integrate bank and payment communications (including payment status) to always ensure real-time reporting on cash and liquidity.
- **Concur Invoice**
  Deployed on the cloud only and supports invoice spend type, invoice automation, invoice conversion services (paper to digital), workflow, invoice matching, automated vendor payments, and B2B payment capabilities. It's designed for all enterprises but currently doesn't integrate with SAP S/4HANA, although it's planned for the future. We'll discuss SAP Concur further in Chapter 13.

What's Right for You?

We've touched on a variety of solutions offered by SAP—now, you may be wondering how they all fit together and the business landscapes they would best fit. Depending on your business needs, you may have to consider each of the following offerings in conjunction with one another and not necessarily as a direct replacements:

- SAP Invoice Management by OpenText: You might consider this option as a one-stop shop to enable you to process all invoices from suppliers from both manual or electronic channels (e.g., Ariba Network, Electronic Data Interchange [EDI]).
- SAP Ariba Payables: If you're a large enterprise and want to take advantage of the benefit of the Ariba Network, you can manage your working capital and cash flow by taking advantage of early discounts with a flexible payment option.
- SAP Ariba Invoice Management: This capability is similar to that of SAP Invoice Management by OpenText in the sense that it enables the user to process all invoices electronically, including invoices submitted via the Ariba Network, paper invoices from an outsourced service, or those indexed by AP using configurable workflows.
- Concur Invoice: Again, this is a similar invoice management tool geared toward businesses that have significant invoices relating to travel, cargo, and logistics.

9.7 Asset Accounting

We'll now turn our attention to fixed asset accounting and the fixed asset register. At the nucleus of fixed asset accounting is the desire for a company to keep track of the "book value" of its assets and to determine depreciation for management and taxation purposes.

But first, what is a fixed asset?

In Section 9.2, we outlined two types of assets: tangible assets and intangible assets. Intangible assets refer to nonphysical assets such as trademarks, goodwill, and patents, whereas tangible assets refer to assets with a physical form. Tangible assets are further broken down into two groups:

- **Current assets**
  Examples of current assets include AR and inventory; they are things that can reasonably be expected to be converted into cash within one year.
- **Fixed assets**
  Unlike current assets, fixed assets aren't expected to be consumed or converted into cash within one year. Examples include property, plants, and equipment; they are also sometimes referred to as capital assets. It's this final category that is the focus for this section.

The fixed asset lifecycle can be considered as comprising the following six stages:

1. **Procuring assets**
   From a procurement perspective, the purchase of an asset generally takes place in the same way as the procurement of any other item. From a finance perspective, this will either take place when an invoice is received or when the asset is entered into the fixed management system.
2. **Registering assets**
   Some of the information needed to set up an asset for depreciation in the fixed asset register (FAR) includes acquisition date, placed in service date, description, asset type, costs basis, and depreciation basis.
3. **Adjusting an asset**
   After we have an asset on the FAR, adjustments to these assets may have to be made. For example, there may be improvements or repairs made to the asset that will either add value or extend its economic life. These will have an affect on depreciation.
4. **Transferring an asset**
   There may be occastions within the life of an asset when it needs to be transferred to another department or subsiduary. Such changes may impact the depreciation basis of the asset or other aspects of the asset data.
5. **Depreciating assets**
   The depreciation of an asset is the systematic reduction of the recorded value of the fixed asset. Depreciation must be reflected within a company's books. Assets are depreciated at standard rates; however, a reevaluation of an asset's value can also lead to appreciation (increase in value).
6. **Disposing of assets**
   At the point when a fixed asset becomes obsolete, is removed from use, or is beyond repair, it's typically disposed of. Disposal includes abandonment but can also cover sale and trade in. At the time of disposal, the difference between the vlaue and any value realized is reported as a loss or gain.

Customers on classic AA looking to transition to SAP S/4HANA or equivalent will have to adopt the New AA. This is based on new G/L accounting with the ledger approach or accounts approach.

AA in the SAP S/4HANA system is used for managing and monitoring fixed assets' lifecycles from acquisition to disposal. In FI, as discussed earlier, it serves as a

subledger to the G/L, providing detailed information on transactions involving fixed assets.

Some of the features of AA in SAP S/4HANA to point out include the following:

- Simple, faster, soft close with faster depreciation run based on a simplified data model and in-memory technology of SAP S/4HANA
- Fixed asset accounting now based on the Universal Journal
- New posting logic with the ledger approach to parallel valuation
- Transparency with new tranactions created for ledger groups based on depreciation area

9.8 Real Estate Management

Let's now examine another component of finance in terms of real estate management that needs to integrate with the financial ledger. For organizations that hold a real estate portfolio of purchased assets or leased assets, they will need a process to manage and report on this asset portfolio from a statutory perspective.

The real estate management process could be quite broad and include processes that support the management of corporate property to commercial property. We won't be able to do this great justice by explaining all processes involved, however, we'll provide an overview of the real estate and lease accounting processes as they impact finance.

We'll now explore the three key elements that form part of the real estate management process:

- **Lease accounting**
  This is the process of managing financial and operating lease to ensure that the lease is represented fairly, reliably, and accurately in the financial statement. Under the International Accounting Standard (IAS) 17, there are two types of leases:
  - Finance lease: A lease in which the risk and reward of ownership rests with the lessee (i.e., the person in use of the assets).
  - Operational lease: A lease in which the risk and reward of ownership rests with the lessor (i.e., the person providing the asset for use).

  However, with the introduction of IFRS 16, users are now required to recognize assets and liabilities arising from a lease in their financial statements. This is to

ensure that the lessee reflects the correct "right of use" in the financial statement for leases with a term of more than 12 months and the asset value is deemed high. In summary, organizations such as Bault Robotical, with leased property, will have to recognize their lease as follows (effective from January 1, 2019):

  - Finance lease: Will remain to be treated as a finance lease.
  - Existing operating lease: Partial or full restatement of assets to reflect new standards.

- **Contract management**
  As you know, procuring a property or renting a commercial property could be considered serious business and will require legal involvement and a contract. A real estate contract is in essence a written agreement between the buyer and seller for the conveyance of the property.
- **Real estate transactions**
  You can create real estate records such as invoices and billing data. Rental payments for items such as utility bills can be managed as part of real estate payments.

Flexible Real Estate Management (RE-FX) in SAP S/4HANA is the solution to manage your real estate portfolio as well as the new IFRS 16 lease accounting standards. The features enable you to manage real estate master data as a business entity and building property in either the architectural or usage view. It enables you to manage the contract relationships as business partners. You can also set up different contracts (e.g., lease-in, lease-out, service, and maintenance contracts) as well as contract terms, conditions, subjects, and key dates, that are fully integrated with the FI and CO modules of SAP.

The valuation functionality using valuation rules, calculation of asset depreciation, and liabilities based on right of use are valuated according to different accounting standards. It also supports the different transition scenarios from the old accounting principle.

The reporting supports direct cash flow integration as well as extensive reporting on the valuation of contracts.

9.9 Financial Consolidation

Let's look at another key financial closing operation that only applies to companies with multiple legal ownership and interests. If you're working in a single entity

organization, then this section isn't for you However, if you're involved with global or multinational companies, then keep reading.

Financial consolidation is the process of combining the financial results of several subsidiary companies where the legal ownership and control of the parent company is more than a certain percentage—usually 50%—into the combined financial results of the parent company.

Key steps in financial consolidation process include the following:

- Collecting trial balance data (e.g., assets, liabilities, equity, revenue, and expense accounts) from multiple G/L systems of each subsidiary and mapping the data to a centralized chart of accounts by the parent company, as discussed earlier
- Consolidating the data following specific accounting rules and guidelines, such as US GAAP or IFRS
- Reporting results to internal and external stakeholders

We'll look at the five key areas that support the preparation of a consolidated financial statement:

- **Currency conversion**
  In SAP S/4HANA, exchange rates are upload using a standard template and used to support foreign currency revaluation and translation. Companies operating on a global scale will need to consolidate their results, and the financial results of their subsidiary companies will need to be converted using the exchange rates stored in SAP to their parent's reporting currency. This forms one of the key steps of the financial statement consolidation process. With the fluctuation of the British pound recently against the dollar and euro, as part of their consolidation process, organizations (e.g., Bault Robotical) will need to remeasure the financial statements of the foreign entities in Europe and the United States into the "GBP" reporting currency where the parent company is registered. Subsequently, any gains and losses on currency translation will be recorded as part of the consolidation process.
- **Eliminations**
  Elimination of intragroup transactions such as intercompany loans, are carried out. You also need to offset the carrying amount of the parent's investment in each subsidiary and the parent's portion of equity of each subsidiary. In addition, eliminate unrealized profits as well as intracompany transaction settlements of the investment value of the organization.

- **Consolidation**
  As part of this process, you combine like items of assets, liabilities, equity, income, expenses, and cash flows of the parent with those of its subsidiaries. You check the accuracy of the consolidation by verifying the intercompany matching reports, running the consolidation process, and making manual adjustments if required.
- **Group reporting**
  The user validates the consolidated statements, adds annotations and other non-financial information, and produces the statutory reports and the notes to the financial statements.

SAP offers several different solutions to support financial consolidation. Some of them are new, and the products are aimed at different customers based on the complexity of their business. Let's explore the key solutions offered by SAP, as follows:

- **SAP Financial Consolidation**
  With SAP Financial Consolidation, you can now run your enterprise consolidation reporting in real time. Traditionally, it takes months for organizations to consolidate financial statements, especially across a complex enterprise. If you have one instance of an SAP ERP or SAP S/4HANA system or a highly decentralized heterogeneous environment, SAP Financial Consolidation gives you an integrated and speedy consolidated solution to financial reporting.
- **Real-Time Consolidation (RTC)**
  RTC is a consolidation solution based on the deep integration between SAP S/4HANA and SAP BPC.

  One of the main benefits of adopting RTC is that there is no longer a need for master data replication between your SAP ERP and consolidation system. Data such as company codes, G/L accounts, profit centers, and segments are maintained once and shared between SAP S/4HANA and SAP BPC. There is no longer the need for a nightly refresh to run consolidated reports because the data is embedded within SAP S/4HANA and consumed via SAP HANA views. RTC has direct access to Universal Journal entries (table ACDOCA) and uses the consolidation capabilities from SAP BPC's rule-based consolidation. It's also able to combine both planning data and actual data in one model. By using data from the Universal Journal directly in SAP BPC, RTC achieves consolidation on real-time financial data.
- **SAP BPC 11.0 for SAP BW/4HANA**
  Financial planning and consolidations (SAP BPC 11.0) offers an alternative option for providing financial consolidation for customers. It aims to leverage financial

and operational data from multiple data sources. SAP BPC 11.0 for SAP BW/4HANA is for planning and consolidation with a standalone deployment.

- **SAP S/4HANA for group reporting**
  As part of SAP's latest offering (SAP S/4HANA release 1809) SAP S/4HANA Finance for group reporting is offered for legal and management consolidation within the same SAP S/4HANA system. Group reporting offers real-time access to local accounting information during the consolidation process. Both entity and consolidation data are managed within a single instance, providing greater transparency and control. Key features of group reporting include continuous accounting, integration with SAP Analytics Cloud, as well as group reporting on the cloud.

What's Right for You?

We've touched on a variety of consolidation solutions offered by SAP—now, you may be wondering how best to choose a version that fits within your business landscapes:

- RTC (SAP BPC for SAP S/4HANA): This is best suited where the majority of the data upon which planning or consolidations will be performed resides within the SAP S/4HANA system.
- SAP BPC 11.0 for SAP BW/4HANA: This is best suited to where financial and operational data is taken from multiple data sources.

- **Central Finance**
  Central Finance is an SAP S/4HANA system that receives FI transactions through real-time replication from SAP and non-SAP source systems. Central Finance comes with a set of enabling technologies and offers a nondisruptive SAP S/4HANA migration option in as little as three to six months. Central Finance offers the following key features:
  - Synchronization with data harmonization and information standardization.
  - Transformation of the finance organization.
  - SAP S/4HANA system consolidation and reporting in one system, featuring integrated planning, consolidation, transaction recording, and reporting.
  - Automation with zero-touch finance and exception-based finance management and financial operation.

We'll revisit SAP BPC in Chapter 10 and Chapter 11, in the context of planning and control and enterprise performance management, respectively.

9.10 Governance, Risk, and Compliance

Following various global corporate accounting scandals, organizations are keen to provide adequate preventative finance governance and controls to provide assurance to stakeholders that the financial statement reflects a true and fair view of its affairs.

Governance, risk, and compliance (GRC) are three areas that provide assurance to an organization that it has controls and procedures in place to enable the organization to achieve its objectives, address uncertainty and risk, and conform to required standards.

GRC is referred to as a discipline that provides "three lines of defense" within an integrated framework across an organization. The three can be further defines as follows:

- **Governance**

  Governance is a theoretical concept that consists of rules and standards and, in the corporate world, defines processes, customs, policies, and laws that affect the way a business is directed. Some of these rules and standards may be defined by regulatory or government bodies. Others are purely internal and used to support business process quality and efficiency.

  Corporate governance is influenced by internal and external parties. Internally, the board of directors and management are key to defining and establishing governance protocols. They in turn must consider the wishes of shareholders, lenders, suppliers, and government. Then, of course, there are the employees who should perform their work within the governance structure.

  By operating within an agreed on and defined governance structure, the reputation of an organization with its key stakeholders is enhanced and positive.

- **Risk**

  The International Organization for Standardization (ISO) has a standard (31000) that covers risk management. It recognizes that risks affecting an organization can impact financial performance together with professional reputation. With economic uncertainty and therefore risk caused by a variety of reasons, such as political decisions or environmental considerations, a business needs processes in place for effective risk management for mitigation.

  Risk management itself involves identifying, evaluating, and prioritizing risks, including the probability that a risk will materialize and impact the business. At the same time, remember that some risks may also present opportunities to the business.

- **Compliance**
  Compliance is to conform to a rule. In the business sense, this can refer to prescribed standards (e.g., industry), regulations (e.g., legal), specifications (e.g., design), or laws (e.g., government). The "rules" can be defined internally within a business by, for instance, the finance function for things such as signing off on expenditures, or procurement, for determining which suppliers should be used for specific goods. Alternatively, they can be defined by outside bodies such as government or regulatory bodies.

  Compliance is key to an organization because failure to do so can result in expensive penalties, impact on reputation, or poor productivity.

A consistent theme in finance is the management of risk. A business faces many challenges and has a number of responsibilities to its customers, suppliers, shareholders, regulators, and so on. The GRC products are designed to support this.

GRC is now embedded as part of SAP S/4HANA and seeks to provide three lines of defense mentioned earlier: automation and monitoring of risk, control, and audit. They each require different products, as follows:

- **SAP Risk Management**
  This solution identifies, analyzes, and monitors risk, thus enabling the business to make informed decisions to protect the business reputation.
- **SAP Process Control**
  This solution is designed to improve the effectiveness of internal control processes across both SAP and non-SAP systems.

  It can offer major benefits to key functional areas within the business, including operations, compliance, risk management, controls, and internal audit. Once in place, it acts as a control hub, providing a single internal control system that confirms controls and ongoing compliance across the organization.
- **SAP Audit Management**
  SAP Audit Management automates internal auditing procedures. The product leverages SAP HANA technology to support quick and easy documentation of evidence, working papers, and creation of audit reports.

In addition, SAP Cloud Identity Access Governance is used to manage and control user access to the SAP system and its data together with non-SAP systems. In a similar vein to SAP Process Control, it monitors compliance against policies and mitigates against risk in key business processes.

The tool is designed not just for management but also to empower users by managing system access requests made by users and their approval.

Cross-border trade can be lucrative but also has its own risks around tariffs and regulations. SAP introduced SAP Global Trade Services (SAP GTS) to streamline and manage cross-border supply chain processes. The solution is specifically designed to manage exports and imports together with trade agreements. The benefit of this is that a business can mitigate the risk of breaching compliance and thus incurring fines and impacts on reputation.

9.11 Treasury Management

The treasury management process involves the management of a company's financial assets that will impact liquidity and its ability to meet financial obligations. For a smaller organization, the focus is around the management of funding and management of financial risk. This includes the management and analysis of incoming and outgoing funds. Larger organizations will often invest in financial products, such as bonds, and trade in foreign currency. The treasury function in the business is responsible for the management of financial risk associated with this.

SAP S/4HANA Finance for treasury and risk management, which again is designed to maximize the power of SAP S/4HANA by giving a business the ability to accurately manage liquidity and cash in real time.

SAP has applied significant innovation to the area of cash management and treasury with SAP S/4HANA, not only with its treasury and analytics SAP Fiori apps but also in the reporting capabilities, as shown in Figure 9.7. The main function of cash and liquidity management is to enable organization and treasury functions to manage their partner banks centrally. As part of cash and liquidity management, the two main reports, FF7A – Cash Position and FF7B – Liquidity Forecast, have now been elevated through the SAP Fiori user experience. Users are now able to have an overview of the organization's cash operations for medium- to long-term liquidity trends. Cash managers can easily get a high-level overview and detailed insights into bank accounts, cash position, and cash flows on any device, which enables them to make decisions and take actions directly.

Payments and bank communications management streamlines, controls, and gives better transparency into business' communications with your banks as discussed previously. By using the SAP In-House Cash application, you can reduce the number

of external bank accounts and centrally process internal and external payment transactions within a company or group.

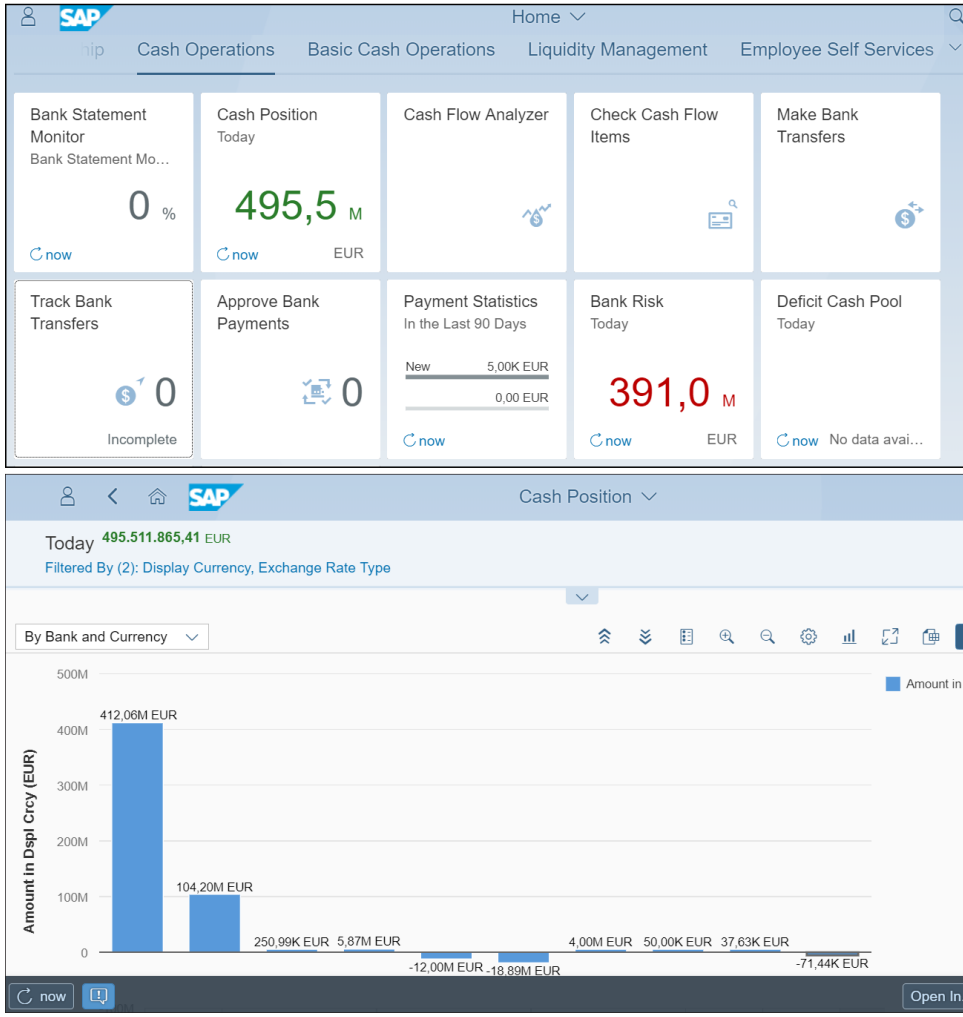

Figure 9.7 Cash and Treasury Reporting in SAP S/4HANA

With integration across SAP S/4HANA, the cash position of the business is close to hand. For businesses that deal with or hold financial products, such as bonds, derivatives, and other securities, through exposure management, risk can be monitored by allowing mitigating action to be taken to protect the cash position. The

product also benefits from integration with some of the newer SAP Cloud products such as SAP Cash Application (discussed in Section 9.5). From a compliance perspective, the SAP Cash Application is designed to support the business in meeting compliance standards such as IFRS9.

9.12 The Road Ahead

From an SAP portfolio perspective, the core SAP S/4HANA Enterprise Management functionality remains the core with functionality such as the Universal Journal removing the traditional boundaries of FI and in doing so providing real-time information to organizations to facilitate better information and better decisions. SAP S/4HANA provides the most mature suite fully available in the cloud and on premise.

The road map for FI and potential innovations ahead with extension to the SAP digital core include the following:

- Leverage of soft close and prediction in sales order processing.
- Provide further unification in both local and group close processes.
- Provide further directions in accounting, and financial close will see matrix consolidation and the automated consolidation of investment.
- Adopt legal changes in revenue accounting, providing further automation to meet IFRS 15 requirements.
- Leverage SAP Cloud Platform for finance applications for goods receipt and invoice receipt monitoring.
- Leverage SAP Cloud Platform for real estate for corporate real estate management.
- Enhance liquidity forecasts with integration of project system data.
- Proposal to increase automation of bank account management with electronic Bank Account Management (eBAM).
- Provide predictive liquidity forecast utilizing machine learning, and provide enhanced treasury reporting capabilities.

In the next chapter, we'll dive into the other side of finance: management accounting.

Chapter 10

Management Accounting with SAP S/4HANA

In Chapter 9, we dove into the basics of financial accounting (FI) and the various SAP products that support the key processes. Now, we'll do the same with the other half of finance, management accounting.

Management accounting or controlling (CO) is concerned with the internal management of an organization. This is achieved by providing up-to-date and accurate information that allows the management of the company to make optimum decisions.

To finance and nonfinance individuals reading this chapter, management accounting (CO) is an area that you might have come across, as you most likely would have been involved in preparing or consuming one form of report or another used to support the decisions made in your team or department—that is, a management report. To that end, management reporting is an area that most people are more likely able to relate to because the process usually involves more people in the organization, from top executives, senior managers, and mid-level managers to line managers responsible for day-to-day operations of the business. These processes could include sales, manufacturing, marketing, production, maintenance, IT, administration, and so on that ultimately affect the organization's bottom line.

CO differs from FI in several ways:

- **Consumers**
  The primary consumers of FI outputs are external persons such as governments, shareholders, financial institutions, and customers. Within CO, the consumers of the information are intended to be internal and specifically management who use the information gathered to make strategic decisions, track progress, and make plans for the future.
- **Time focus**
  The purpose of FI is to present either a current snapshot of the health of an organization or a view of what happened historically, such as in the last month, quarter,

or year. One of the main focuses of management reporting is to plan the future of the organization and then to see how the actual performance compares to this plan.

- **Subject**
  FI looks to provide information for an entire company, whereas management reporting looks to provide actionable information per segment. For example, management reporting will look to answer operational questions such as should the organization procure new production machines as well as answering questions such as what the marketing budget should be next year.
- **Rules**
  FI is a formal process designed to produce standard outputs that can be consumed in a uniform manner, governed by rules such as Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS). Management reporting isn't subject to the same level of scrutiny and rigidity, and each company has the option of segmenting CO information into whatever form best fits.
- **Requirement**
  FI is a mandatory requirement for companies and must follow formal processes and procedures. CO is once again at the discretion of each individual company and how, or even if, it's done isn't enforced by an external body.

It's safe to say that because FI is concerned with reporting information externally and is based on a unified set of principles or generally agreed on guidelines for reporting, it could be considered more of an exact science. Whereas on the other hand, management reporting is more of an inward-looking activity and left to the discretion of its managers and accountants within the organization on how to report its activities.

In this chapter, we'll explore the key CO business processes (overhead cost management, product costing, profitability analysis [CO-PA], and more) and how they are supported in the modern SAP landscape. First, let's take a look at the state of CO in our business case.

10.1 Business Case

As we identified in the previous chapter, Bault Robotical is looking to expand its operations into other markets. However, to have a complete picture of the business, the senior executives and the board are counting on the information provided by its CO

team to assess its financial and nonfinancial data that would enable Bault Robotical to reach such a strategic decision.

Bault Robotical is faced with the following challenges and needs management information and insight to support its decision-making process:

- Bault Robotical needs to determine whether to invest in the acquisition of various research and development (R&D) and fixed assets. It will be looking to its finance function to provide information that supports the annual creation of an investment plan and budget around its latest capital investments to be monitored globally.
- Facing increased competition and in light of Brexit, Bault Robotical needs to assess its key operations across the UK, European, and US regions. The managing director of Bault Robotical is concerned with the budget preparation for the following year and needs to ensure that the budgetary process is managed, monitored, and controlled effectively. As part of this process, the organization is looking to incorporate an annual rolling forecast.
- In the UK market, Bault Robotical is looking to introduce a new product line following a trial in some of its London stores and needs to decide on product pricing. Before it expands to other UK regions, it also needs to assess the profitability of the product across its stores.

We'll now demonstrate the process of preparing management accounts and financial statements aimed at providing short- to medium-term information for the management of Bault Robotical. We'll reveal how management accountants in each region work together to provide key analysis that includes budget, plan, actual, and variance analysis. We'll explore how SAP Business Planning and Consolidation (SAP BPC) supports the generation of different plans, including sales, capital, and operational plans. We'll also explore key CO concepts and models (product costing, CO-PA, activity-based costing [ABC], resource-based planning, investment management, and Project Systems [PS]) and consider the integration with the General Ledger (G/L) and FI.

Out with the Old

Traditional management reporting has in the main been delivered through the CO module in SAP ERP following the closing of the financial ledger and running subsequent CO activities, such as overhead allocations, with time taken to reconcile FI and CO in some cases to ensure the data flows reflected in FI were correctly reflected in CO. Even with the new G/L, consultants would have to grapple with setting up the

real-time reconciliation to ensure FI and CO were always in sync! With the introduction of the Universal Journal in SAP S/4HANA, real-time integration is no longer required, as CO data directly moves to the Universal Journal.

One of the major limitations with CO reporting in SAP ERP was the lack of ability to deep dive into cost center, profit center, and CO-PA type reports as standard, without the complexity of building custom reports using native tools such as Report Painter and Report Writer or reporting externally via an SAP Business Warehouse (SAP BW) system.

With SAP S/4HANA and SAP S/4HANA Cloud, SAP has come up with a simplified data model (Universal Journal), which we've mentioned in Chapter 9, that allows for faster and more transparent reporting. This also means that some of the CO transactions have been replaced, and transactions ending with H, have been optimized for SAP HANA (e.g., Project Settlement – Transaction CJ8G to Transaction CJ8GH) as you'll see throughout the chapter.

The system now supports integrated financial planning with SAP BPC for SAP S/4HANA. This is through the extension of the Universal Journal to include planning data (table ACDOCP).

10.2 Cost Management

Cost management is a key element of achieving business goals, and understanding the nature of costs and putting controls in place is of prime importance. However, achieving the desired financial profit requires a business to understand its market, customers, and competitors. To get a full picture, a business needs to combine analysis of both costs and profitability, which will be discussed in Section 10.4.

The basic requirement in CO is to provide information to support decision-making, with the nature of decision-making varying from task to task. Within this, cost management is looking at attributing cost to achieve a given cost objective and is concerned with collating costs for the calculation of product or service costs to achieve a given desired measure on which a decision can be made. It essentially encompasses the process of identifying the total cost of expenditure to which the product or service is considered viable for a business to pursue.

We can break down this process into two main areas:

- **Direct costs**
  Direct costs are totally attributable to the production of a product or the delivery of a service. This can be further broken down into the following:
  - Direct material: This includes costs of all material purchased for a particular job, material acquired and goods issued from a store or warehouse, components purchased or produced as a result of passing from one manufacturing process to another, and any other primary material or spend associated directly to the product, for example, packaging or transport cost.
  - Direct labor: This is the labor cost attributable to making the product or delivering the service. These costs include salaries paid to skilled, unskilled, part-time, or full-time workforce and payments made to contract staff for work that can be directly charged to the product/service.
  - Direct expenses: These costs are other than direct material or direct labor that is incurred in the production of a product or delivery of a service. For example, the hiring of a specialist tool in Bault Robotical that is used in the manufacturing of its products is considered a direct expense.
- **Indirect costs (overheads)**
  Indirect costs are all other overhead costs that aren't directly attributable to the production of a product or the delivery of a service. This can be further classified into different groupings depending on each organization's needs. Examples include the following:
  - Production overhead: These are costs incurred as part of the end-to-end order and delivery of the product or service. Examples include rent, rates, and insurance costs associated with running the plant.
  - Administrative overhead: This comprises all costs associated with management and day-to-day operation of the organization. Examples include office lighting and heating, cleaning costs, and so on.

Another concept to be aware of and quickly explore as part of cost management before describing the feature offered by SAP S/4HANA is that of controllable and uncontrollable costs. For a controllable cost, a manager can control or influence its behavior. On the other hand, uncontrollable costs are those that a manager has no way of controlling at his level.

Figure 10.1 outlines a simplified cost analysis, showing both the direct costs and the indirect costs that aren't attributable to the production of a product or delivery of a

service. Note that the cost breakdown can be subjective and may vary depending on your organization's definitions of costs. The key point is that whatever definition is used, it has to be technically sound to produce information to support the decision-making needs of the company.

Simplified Cost Anaysis		
Direct Costs		
Direct Material	5,000,000.00	
Direct Labour	2,000,000.00	
Direct Expenses	800,000.00	
		7,800,000.00
Overheads		
Production	1,600,000.00	
Administrative Expenses	200,000.00	
Sales and Distribution Expense	400,000.00	
		2,200,000.00
Total Cost of Sales		############

Production cost

Figure 10.1 Simplified Cost Analysis

The main basis of structuring and reporting costs/revenue in CO is made up of cost/revenue elements. In SAP S/4HANA, cost and revenue elements now form part of the chart of accounts. As discussed in Chapter 9, G/L accounts with G/L account type primary cost or revenue or secondary costs identify primary or secondary elements, respectively. This makes it possible to run a full cost analysis (controllable and uncontrollable costs) as part of your financial statement.

As of SAP S/4HANA 1709, you can manage flexible hierarchies for cost centers and profit centers, and you can use semantic tagging to add alternative ad hoc structures or reporting views of the same data. By so doing, you can create and maintain hierarchies flexibly by adding and defining the sequence of the attributes, such as region, department, and so on. You can then run reports on the fly that fetch the hierarchies based on the determined attributes.

In SAP ERP, cost of goods sold (COGS) was posted to one G/L account, with details of material, labor, and material costs being easily displayed. In SAP S/4HANA, the ability to work out the COGS is now simplified with the COGS split functionality. By defining the basic cost component structure used during the production of a good or delivery of a service, costs are itemized by the nature of the expense. SAP S/4HANA provides the capability to map the COGS at the time of sales order delivery and posts the split using a standard costing estimate for the material or unit cost estimate for the sales order item. Alternatively, you can use a different basis for the split, such as prior or future year cost estimates. This provides greater transparency to the management accountant and managers on the unit cost associated with each order.

Another game changer we've seen is that with CO-PA in SAP S/4HANA, the COGS gets recorded in the CO-PA segments at the time of order delivery. After the billing process is run, this information is available in finance to be displayed in real time in the Universal Journal. Detailed production cost variances, such as quantity variance and scrap, can now be defined at the account level, and variances can be investigated within the Universal Journal.

SAP S/4HANA also offers standard functionality to support overhead cost accounting, including the following features:

- Recording of primary costs to a cost center
- Defining statistical key figures (SKFs), such as floor space, number of call center telephone lines, and so on, as a basis for period-end allocation of costs
- Overhead cost allocations using distribution or settlement using primary or secondary cost elements, respectively
- Accrual calculations as a basis for planning
- Running cost center reports via the SAP Fiori launchpad

10.3 Planning and Control

The basic purpose of planning is to establish goals for the business, specify how these goals will be achieved, and decide how budgets will be developed.

There are three main types of planning:

- Strategic: Strategic planning is the process of developing the strategy or direction of a business and the plan of action to achieve these goals.

  The key elements of any strategic planning process are as follows:

  - The vison, mission, and values are developed and understood.
  - Internal and external factors affecting the organization are assessed that will help evaluate the planning options to succeed.
  - A high-level view is taken of the resources required to achieve the strategy.
  - Planning is usually defined at the director level.
  - Planning is long term, at least one year.
- Tactical: Tactical planning is the process of implementing the defined business strategy and objectives. Key points to note around planning at this level are as follows:

  - Time horizons are shorter, that is, measured in months or quarters.
  - Tactics used by the business should be consistent with the defined strategy.
  - Decisions are often taken by the level below the directors (divisional managers).
- Operational: Operational planning is concerned with the day-to-day operations of a business. Key elements to consider are as follows:
  - Timescales are daily or weekly.
  - Operational plans are department focused.
  - Budgets are based on departmental operational plans.

Planning is a critical success factor for any business, but to achieve its desired goals and objectives, a business must have effective cost management in place to bring budgeting under control. Of equal importance to a business is to be profitable by ensuring that it earns more money than the costs it generates. For a private company, profits are distributed to shareholders as dividends and thus are key to the perception of the business to potential investors and the wider business community.

There are four key elements to planning:

- **Budgeting, planning, and forecasting**

  The budgetary process supports an organization with effective management of its planning, coordination, control, performance evaluation, and communication of its agreed objectives. A budget could be considered a detailed plan for income and expenditure, regarding a future period.

  The budget process has to be administered effectively. The process needs to be managed from initial planning and review, final approval, and subsequent monitoring.

  After the resources required and cost estimates are in place, the business can formulate a budget and delegate this to different departments. Departmental or cost center managers now have a plan to work toward and a budget allocated to achieve it. The management accountants in the business will collect actual data and measure this against the budget. Different departments or divisions within an organization will typically have their own budgets.

  A typical budgetary process is summarized as follows:

  - Communicate the organization strategy and objectives to budget owners.
  - Communicate the timetable and procedure to those responsible for budget preparation.

- Prepare the initial set of budgets.
- Negotiate the budget among budget owners.
- Review and approve the final budget.
- Conduct a continuous review of the budget as implemented throughout the year.

The various plans, such as a production plan, feed into the overall budget.

- **Resource planning**
  The majority of business costs are made up of labor and material costs. Direct and indirect staff costs must be considered together with any associated overhead. Likewise, materials, both raw and finished, are required to manufacture a product. The business must be able to plan the requirements of all of these to manufacture or sell to achieve the required sales turnover. These costs may vary depending on local factors regarding where the business operates and different markets.
- **Cost estimation**
  Calculation of the costs of producing a product must be accurate for the business to set an appropriate sales price that delivers the required profit margin. Many of the costs will be estimated due to fluctuations in the cost of materials and labor. A business will have different versions of a plan with different estimated prices to budget as accurately as possible and to absorb market fluctuations.
- **Cost control**
  The finance department will support the business by measurement of actual versus plan. A regular forecast can be created from this that will highlight issues to senior management and provide an opportunity to make changes to the business objectives to either get back on track or to optimize the opportunities available if performing well.

  To manage costs, the business should have a number of processes and procedures in place to restrict, for instance, purchases outside of budgeted values. This extra expense will be approved, and the finance department can measure the impact against budget.

The purpose of controlling is to evaluate the performance of each area compared to the plan. This is achieved by management accountants comparing actual results with predicted or expected results; the differences between the two are calculated and communicated as variants. A positive variant is better performance than expected, whereas a negative variance is worse performance than planned. Large variants will be investigated by management accountants to determine why the variance

occurred. Differences may be due to miscalculations in the budget or changing economic factors (e.g., the global change in price of certain commodities) or could equally be down to poor decisions and inefficient processes.

A business should bring all costs and revenues together at an operational level to empower managers at this level to deliver the sales and profitability objectives.

SAP's purchase of OutlookSoft led to the release of SAP BPC (Microsoft and NetWeaver versions). Over the past 15 years, a number of versions of the application have been released with the original SAP NetWeaver version becoming more and more integrated with SAP ERP and SAP S/4HANA. The product is now the main financial planning tool available from SAP S/4HANA, and again there are two options:

- **SAP BPC 11.0 for BW/4HANA**
  SAP BW/4HANA is an external data warehouse running on an SAP HANA database, allowing for simpler, faster, and more flexible reporting. SAP BPC 11.0 is the latest version in the SAP offering as of 2018, that is, in effect, standalone, and it can take data from SAP and non-SAP systems, providing a unified source of truth for planning. There are standard data extractors, (or via flat file) and the full functionality of the product is available from a master data and customization perspective. It's supported for both on-premise or cloud.
- **SAP BPC for SAP S/4HANA (integrated planning)**
  This integrated planning version is ultimately designed to replace the traditional planning functions in the backend system. To support this, SAP provides a number of accelerators/templates (workbooks), including the following:
  - Cost center planning
  - Project planning
  - Internal order planning
  - Profit center planning
  - Balance sheet planning

  The standard delivered planning workbooks allow you to plan costs and revenues using familiar Microsoft Excel spreadsheets. The integrated planning capability makes it possible to define and cascade plans from company codes, hierarchies, and G/L accounts over periods (disaggregation), as well as aggregate data upward. It also provides the capability to copy plans from prior year, periods, actuals, and so on. As part of the planning process, you can also manage planning models,

manage financial forecasting, and report on plan actual variances. The overall planning process can be controlled using business process flow (BPF) through a planning workflow.

The embedded model provides a common financial model, real-time access to both master and transactional data, and, crucially, no need to replicate data because it's taken from the SAP S/4HANA database.

What's Right for You?

The decision to adopt standalone SAP BPC 11.0 or SAP BPC for SAP S/4HANA will depend on your organization's business scenario and needs.

If an organization wants to support its planning, budgeting, and forecasting function specifically in a single instance of SAP S/4HANA where majority of the data resides, the decision should be to adopt SAP BPC for SAP S/4HANA, which is known as the embedded model.

Alternatively, if the financial planning and operations data is being leveraged from multiple sources (SAP ERP, SAP S/4HANA, and non-SAP systems), then an organization might choose to adopt a standalone version as standard.

10.4 Profitability Analysis

Although we've briefly mentioned profitability analysis (CO-PA) in the earlier sections, now we'll dive deeper to understand what management accountants are looking to achieve when assessing how profitable an organization is.

So, what is CO-PA?

It's assumed that the aim of an organization is to make a profit and sustain its profit-making potential. The analysis of an organization's cost and revenue against its outputs to determine if it's going to make a profit is considered profitability analysis. Examples of how an organization may choose to break down its profitability to be discussed further include by product, customer, location, channel, and so on, as shown in Figure 10.2. In SAP terms, these are referred to as profitability segments.

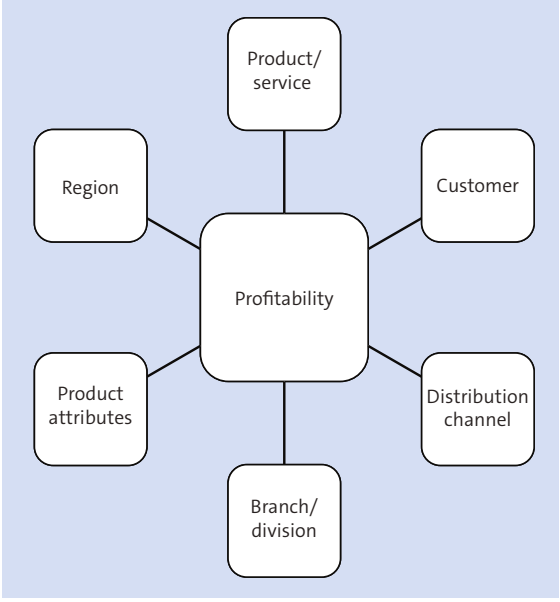

Figure 10.2 Sample Dimensions of Profitability

Let's look at those dimensions in a bit more detail:

- **Product/service profitability**
  This is the process of identifying and differentiating the profitability of different products and/or service.
- **Customer profitability**
  This refers to the cost of activities related to customers from acquisition and retention to management of the customer relationship. This is because there is usually an identifiable pattern to the customer's use of organization resources. By understanding the profitability of customers, the business is able to focus its attention on its most valuable customers.
- **Distribution channel profitability**
  This is based on assessing the effort and resource costs used to distribute an organization's product or service. Companies these days are adopting an omni-channel approach in which a customer can start off browsing on the mobile and end up completing the order in the store. By understanding which is the best distribution channel—retail, wholesale, telephone shopping, online, mobile, and so on—the organization will be able to bear in mind the costs associated with each channel.

- **Product attributes**
  This involves not only assessing the cost and revenue associated with the product but also the attributes or features associated with the product. For example, in a car manufacturing industry, the addition of extra features, such as a fitted sunroof, could be analyzed separately to determine the makeup of the next model.
- **Branch/division profitability**
  This is the process of assessing and identifying which branch, business unit, or division is the most profitable. The management information provided can aid decision-making on whether to close or expand a particular branch.
- **Regional profitability**
  Like the preceding, you can identify and differentiate which region based on their profitability. The management information provided can aid decision-making on whether to close or expand its business activities within those regions.

Within SAP, the CO-PA functionality has been developed to help break down the levels of profitability. We'll explore the different options for managing profitability to understand what this means in SAP S/4HANA.

The following two options are available for CO-PA in SAP S/4HANA, both of which can be maintained depending on your business's needs:

- **Cost-based CO-PA**
  Cost-based CO-PA is defined using the concept of characteristics dimension and value fields. Examples of dimensions are product, customer, region, and so on, whereas examples of value fields include the amounts and groups of accounts. CO-PA allows you to drill down to the level of detail to support management reporting. In SAP S/4HANA, you can use costing-based profitability in parallel with account-based profitability, however, the default and preferred option for SAP S/4HANA is the account-based approach because no further reconciliation is required between FI and CO-PA due to, say, timing differences.
- **Account-based CO-PA**
  Account-based CO-PA has now been simplified in SAP S/4HANA because it's based on G/L account items (similar to SAP ERP) and forms part of the Universal Journal. This is known as simplified profitability analysis because it's 100% reconciled to the financial ledger. The structure of the operating concern for account-based CO-PA is based on characteristics and G/L accounts. The main benefit is that with CO-PA supported by the Universal Journal, financial information is consistently providing a single source of truth for both statutory and CO. For example, within

CO-PA in the Universal Journal, customers can now see the breakdown of balance sheet items such as work in progress (WIP) and unbilled revenue by profitability segments (e.g., product, region, or customer).

The inclusion of profitability segments as part of the Universal Journal is an added advantage that provides more real-time availability of profitability information during the month. This provides management accountants with earlier visibility of associated profitability of market segments without the need to wait for complex jobs to be run at period end.

10.5 Project Accounting

We'll now turn our attention to capital investment and how managers decide to invest in fixed assets and working capital to maintain or increase the resource capacity of the organization. At the heart of project accounting is the desire for a company to plan, manage, and control projects. This could be internal or external R&D projects, consulting-related projects, or large construction projects.

Regarding the different types of projects, there is no clear view on what constitutes a project as every project could be different between organizations. There are various factors that a project manager or accountant can use to classify a project, however, such as the following:

- **Complexity of project, including the following two levels:**
  - Simple projects: Projects where there are few relationships between the tasks, and the project doesn't require complex planning.
  - Complex projects: Project relationships are broad and involve multiple dependencies. These projects require detailed planning and control to monitor spend.
- **Nature of project, including the following types:**
  - IT projects: Projects involved in the development and deployment of IT-related software or hardware. With the digital economy and business startup culture, these sorts of projects are becoming common.
  - Construction project: Projects linked with the building of civil, architectural, and structural work, for example, Network Rail and the Crossrail project in the United Kingdom.
  - Service or production project: Projects adopted by organizations as part of the development of an innovative product or delivery of a service. For example,

this includes a consulting company developing a proof of concept (POC) project for its customers.

- Business projects: Projects relate to the development of a business, management of its activities, and grouping of teams to accomplish work.

- **Organization structure of the project, including the following types:**
  - Functional structure: The projects are managed as part of the same operational function. Projects adopting this structure are typically small projects made up of small teams.
  - Project structure: Dedicated teams are pulled together to work on a project, with the project manager having ultimate control of the project team. Typically, these are medium- to large-size projects involving specialist resources such as in the construction industry.
  - Matrix structure: Resources are typically shared between business work and project work.

As shown in Figure 10.3, a project lifecycle can be considered as comprising five phases per the Project Management Institute (PMI) PMBOK guide, which is the main body for project management professionals. Although it suggests that these are phases and occur in chronological order, each project phase could be managed and run out of sequence.

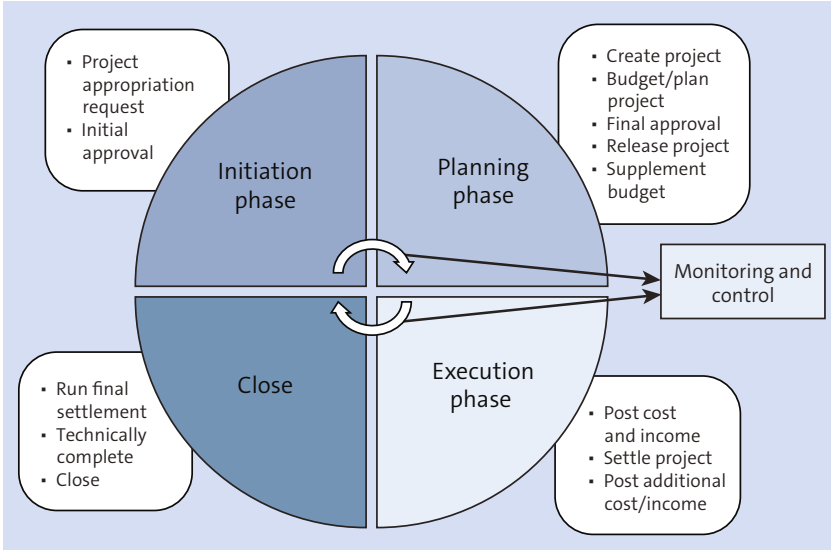

Figure 10.3 Project Lifecycle in SAP

Each phase is discussed briefly here:

- **Project initiation**
  This typically indicates the start of a new project. It's aimed at defining the project at an overall level and answers the questions what work the project aims to achieve, who needs to be involved, and so on. This phase usually starts with a business justification or case of why it should go ahead.
- **Project planning**
  After the initial project is approved, the next phase is agreeing on the scope and developing the detailed plans regarding resources (finance and labor), communication, and so on.
- **Project execution**
  This phase relates to where deliverables are completed. It involves the assignment of the resources to which costs and (sometimes revenue) are incurred.
- **Project monitoring**
  This phase involves the project managers and project accountants overseeing the performance of the project in relationship to the project plan.
- **Project close**
  This phase marks the end of the project, which is completed when the relevant stakeholders sign off on it.

SAP S/4HANA investment management (IM) and project systems (PS) functionalities as well as SAP Portfolio and Project Management for SAP S/4HANA are used to managing project lifecycles.

Let's explore the different investment- and project-related key solutions offered by SAP S/4HANA (which you'll recognize from R&D, as discussed in Chapter 7):

- **Investment management (IM)**
  With IM, project accountants and managers can manage the available sources of funds, requests, and approvals for investment. Project managers and accountants can manage the budgetary control on projects assigned to sources of funding in IM. SAP ensures that projects can only receive budget allocation from the investment program, and the sources of funding aren't over allocated on each project.
- **Project system (PS)**
  Within the PS functionality, you can manage the entire project lifecycle for different types of projects. From the project definition, including work breakdown structure (WBS) and network structures; project release; budgeting and planning;

project execution, including the capturing of costs (and revenues); periodic settlement; and close.

Within SAP S/4HANA, SAP has introduced more than 40 SAP Fiori apps to date, such as My Project, which support the project manager in monitoring and managing these projects effectively.

- **Portfolio management**
  This is part of SAP Portfolio and Project Management embedded in SAP S/4HANA, which has additional license implications. It supports both strategic and operational portfolio management. By integrating information from FI, PS, and HR, it provides a full overview of the project portfolio and resource capacity. A project manager can review plan, actual, and forecast data on their overall portfolio.
- **Project management**
  Similarly, the use of project management has additional license implications and forms part of the SAP Portfolio and Project Management embedded into SAP S/4HANA. Using SAP Fiori apps, this provides the capability to manage the entire project lifecycle across the enterprise from project planning, project execution, and project monitoring to providing real-time project insight.
- **Resource management**
  Similarly, as part of SAP Portfolio and Project Management embedded into SAP S/4HANA, you can now plan resource demand effectively across different projects. The capability allows you to identify available resources via the resource pool; assign resources based on demand, qualifications, and availability; and then monitor. You can optimize your human resources assigned to any given projects. Based on the actual project time booked by employees, the finance department can use the information to bill external projects as in the case of consultancy services that need to bill external customers.

10.6 The Road Ahead

Within the area of CO, businesses are looking to invest further in digital transformation in the areas of Robotics Process Automation (RPA) and machine learning to support planning, big data to provide real-time management insight, and predictive analytics, to name a few.

The road map for CO and potential innovations to the SAP digital core include the following:

- Financial planning and the inclusion of the SAP Financial Closing cockpit for SAP S/4HANA to support both actual and plan data. With this functionality, the planning process can now be managed as part of the closing operations process that includes management reporting. There is further expectation to integrate SAP Integrated Business Planning with sales and operations.
- We expect further planned innovation in CO-PA to support top-down distribution based on the Universal Journal. There will be opportunity in the future to leverage soft close, which provides early visibility on top-down and bottom-up predictions from integrated sources.
- Further enhancements are expected to the planning area to support model configuration that facilitates enhanced what-if scenarios.

In the next chapter, we'll move out of the realm of financial capital and into the realm of human capital, beginning with human resources (HR) and talent management.

PART IV

Human Resources

Chapter 11

Core Human Resource and Talent Management with SAP SuccessFactors

SAP SuccessFactors provides a wide variety of modules to cover the full employee lifecycle hire-to-retire processes. Multiple standard integrations provide connections to SAP S/4HANA with organizational, employee, and absence data to allow payroll, finance, and logistic processes to use their human resources (HR) information effectively.

For a long time, the HR department has been seen simply as the people who hired, fired, and paid in the workforce. Indeed unless you were a hiring manager or had to deal with a lot of questions or issues from your team, you didn't take much of an interest in what HR did or how they did it, as long as you were paid each month. However, HR as a distinct department within organizations has been common since the 1960s, when organizations began to understand the value that good labor relations can bring to a business. In reality, HR is an umbrella term used to categorize a number of different processes and disciplines that all relate to the management and development of a company's human capital—its people. Together with managing and ensuring payroll, the common processes controlled by the HR function include the following:

- Facilitating the recruitment and promotion of employees (and contingent labor)
- Providing the onboarding and orientation of new hires
- Developing and managing employee benefits and wellness initiatives
- Applying personnel policies and disciplinary actions
- Promoting employee career development and training
- Providing insightful management data for informed business decisions
- Ensuring compliance with General Data Protection Regulation (GDPR) for organizations within the European Union (GDPR is a recently enacted regulation in EU law on data protection and privacy for all individuals within the European Union)

However, despite being a distinct function in its own right for more than 50 years, from a business systems perspective and specifically from an SAP ERP perspective, the HR functionality has been somewhat limited to a hire, fire, or pay mentality.

SAP's acquisition of the cloud-based SuccessFactors suite (which itself was a collection of acquired software solutions) in 2012 filled a quite significant HR-shaped hole in its portfolio, providing coverage and capability across both core HR as well as extended business functions.

In this chapter, we'll explore key HR processes, including payroll, recruiting and onboarding, workforce planning, and analytics, and we'll examine how SAP solutions support each process. However, before we do that, first, let's take a look at the HR situation in our business case.

11.1 Business Case

As a core service to an established and mature organization, it may be expected that the internal HR systems and processes at Bault Robotical were also suitably established and mature. However, like many similar organizations, the converse was actually true. For many reasons, Bault Robotical's HR function had seen very little investment over the years, and, as a result, most of its limited processes were handled via manual activity, spreadsheets, and emails. Very few standardized processes existed or standard procedures for dealing with common requests. The department was inefficient and spent a significant amount of time engaged in nonvalue-added activities.

Largely due to the culture in the business, the turnover of staff at Bault Robotical remained low, however, and most people who joined Bault Robotical tended to stay for a significant period of time, meaning that the general activity around hiring was driven more by company growth than the replacement created by employee churn. Furthermore, as the company has been a very successful organization from the start, they haven't had to deal with many of the more undesirable aspects of HR, such as the redundancy of members in their workforce.

At the start of the program, several complaints had been growing louder at Bault Robotical, which were summarized as follows:

- Many in the business felt that they were missing opportunities in terms of succession planning, management, and development of their workforce.

- Despite the organization having a positive, nurturing culture, many employees felt that there weren't supporting processes that allow constructive feedback and development, ongoing support of performance, and learning management and related activities.
- Due to the lack of investment and therefore lack of systemization of what processes they do have in place, the majority of managers tended to rely on their central HR function to support them through processes, needing guidance as they often couldn't remember the manual steps needed to complete activities.

The overall HR approach also led to a very haphazard method to the storing of information. Critical employee records and payroll-related information were stored in secure databases, while pretty much everything else was dispersed across numerous network repositories and individuals' hard drives.

To overcome these issues and to truly transform the HR function alongside the rest of Bault Robotical, it was decided to make use of SAP SuccessFactors. As SAP SuccessFactors and indeed the HR function in general allows for a greater degree of autonomy from the other key functions in a business, Bault Robotical also considered other human capital management (HCM) products and services, including Workday, before deciding on SAP SuccessFactors.

11.2 Hire-to-Retire Process Overview

Hire-to-retire processes cover an employee's full lifecycle within an organization, encompassing actions from the point of hire, to real-time changes to the personal and employment data, through to their retirement from the organization. This can include career progression actions supported by performance and goal modules, top performer reward and retention supported by succession management and compensation module, and professional development supported through the learning module. The SAP SuccessFactors HCM Suite is made up of an array of solutions to address both the employee and the manager throughout these processes. In SAP SuccessFactors, the hire-to-retire business processes are categories within use cases by each solution, but the end-to-end lifecycle of a person in the organization crosses these module boundaries.

The key HCM processes within SAP SuccessFactors HCM Suite are as follows:

- Core HR and payroll
- Time and attendance management

- Recruiting and onboarding
- Learning and development
- Performance and compensation
- Workforce planning and analytics

All business processes are independent within their own module, but as you'll see, they become more effective with shared data transferring between them.

Out with the Old

SAP's legacy HR product is SAP ERP Human Capital Management (SAP ERP HCM), which formed part of SAP ERP. In line with the end of support for the SAP ERP product, SAP accounted that SAP ERP HCM would cease to be supported beyond 2025, replacing the functionality of the on-premise SAP ERP HCM system with the cloud-based SAP SuccessFactors software-as-a-service (SaaS) solution. However, in January 2018, SAP announced that customers could remain with the on-premise SAP ERP HCM until 2030 provided that they switch over to SAP S/4HANA. SAP has made it clear that despite the extension of the timeline, SAP SuccessFactors remains the strategic solution for HR within the SAP portfolio.

For example, SAP SuccessFactors Employee Central as the core human resources information system (HRIS), has a standard approach for hiring (onboarding) a person. This can be prepopulated with information, such as position, name, and personal information, if SAP SuccessFactors Recruiting is also implemented. This in turn can further be enhanced with Employee Self-Service (ESS) information, such as address and bank details collected directly, when SAP SuccessFactors Onboarding is used.

Business processes all have distinct frequencies and timelines. This can have a bearing on when a module is implemented. SAP SuccessFactors Performance & Goals and SAP SuccessFactors Compensation are generally annual activities scheduled specifically to the organization.

Table 11.1 provides an overview of the sequence of HR business processes and their corresponding modules in SAP SuccessFactors.

Sequence	Business Process	SAP SuccessFactors Solution
0	Organizational health and development	Workforce Analytics and Planning
1a	Create position	Position Management
1b	Create job requisition	Recruiting
2	Publish vacancies to job boards	Recruitment Marketing
3	Manage candidates	Recruiting
4, 6	Onboard prehire	Onboarding
5	Hire	Employee Central
5a	Case management	Service Center
5b, 5c	Payroll data (in/out)	Employee Central
5d	Employee data sync	Employee Central
6	Onboard new hire	Onboarding
7	Assign learning and collaborate	Learning and SAP Jam
8	Set goals and review performance	Performance and Goals
8a	Assign learning	Learning
9	Calibrate ratings	Calibration
10	Budget reward	Compensation
10a	Comp data and eligibility	Compensation
11	Calibrate reward	Calibration
12	Pay components and promotions	Employee Central
13	Plan for succession	Succession and Development
14	Assign learning	Learning

Table 11.1 Hire-to-Retire Processes

To achieve the best approach for replacing an HRIS system, SAP SuccessFactors Employee Central is the usual starting point, then expanding forward to include SAP

SuccessFactors Recruiting, SAP SuccessFactors Onboarding, and SAP SuccessFactors Learning.

What's Right for You?

SAP SuccessFactors provides packages for most process areas; these allow for acceleration of an implementation using preconfiguration content via the SAP SuccessFactors Upgrade Center and project templates from SAP Best Practices Explorer. The templates include scope documents and presentations, demo and test scripts, process flows, scope item simulations, configuration guides, and workbooks for an area or process. This tends to be the go-to route because, as a rule, SAP best practices can significantly aid an implementation by defining the business processes that an organization should seek to adopt.

11.3 Core Human Resources and Payroll

Core HR as the name suggests is the spine of the HR function and refers to the key data blocks that collectively feed and receive information from all HR processes. Within SAP SuccessFactors, this functionality is controlled within specific solutions under the umbrella of core HR and payroll:

- SAP SuccessFactors Employee Central
- SAP SuccessFactors Employee Central Payroll

SAP SuccessFactors Employee Central contains the core data pertaining to individuals within an organization because it's both the system of record for HR activities and also controls the workflows for all HR processes. The key components for SAP SuccessFactors Employee Central are now outlined:

- **Core HR for employees**
  The core HR for employees functionality within SAP SuccessFactors Employee Central enables the tracking of all key HR information pertaining to an individual. It allows for self-service entry, which, when adopted correctly, can massively improve the accuracy of employee data and also remove a significant data entry headache from the HR department. It has embedded role-based authorizations, meaning that an organization can quickly and securely decide what information an employee can and can't view and change. SAP SuccessFactors Employee Central can hold a myriad of information pertaining to the employee, such as name,

location, email, phone number, and bank account details. It allows for employees to view pay information, including statements, along with access to live time off information, such as leave balances and time off requests.

- **Core HR for managers**
  Together with providing a central repository for all information relating to an employee's details, SAP SuccessFactors Employee Central also provides the functionality to assist mangers in making important decisions and enabling key processes. From SAP SuccessFactors Employee Central, managers can view team members by organizational structure and then take action, such as initiating the changing of an employee's job, changing compensation, or even initiating a termination, as shown in Figure 11.1.

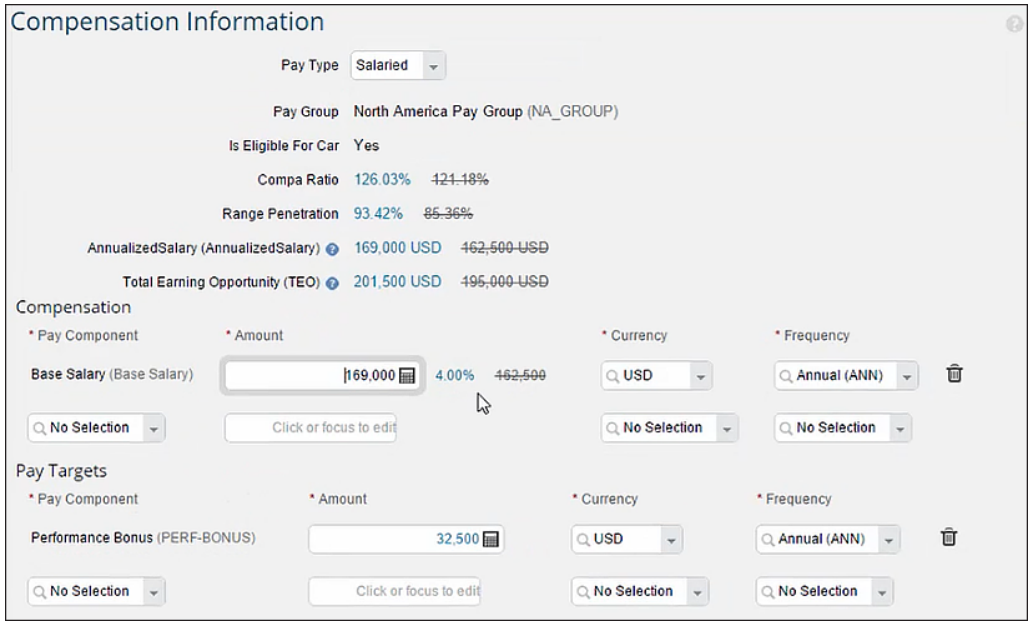

Figure 11.1 Updating Compensation Information in SAP SuccessFactors Employee Central

Manager self-service (MSS) is also bound by role-based authorizations, meaning that managers only have access to the processes and functionality. In addition, it's very rare that a manager will be able to unilaterally decide to make any of the changes outlined previously without input from other contributors within the organization.

Not only can SAP SuccessFactors Employee Central trigger workflows to manage such approvals, but it can also dictate who needs to approve and who should be informed for information purposes. It does this by leveraging the configured organization structure that dictates, among other things, who reports to whom. In the example of a change in job and remuneration package, for example, not only would SAP SuccessFactors facilitate the initializing request from the manager and the following approval workflow, but it would also identify whether the new role facilitated a change in the organizational structure and identify and facilitate the movement of the employee to the new manager.

- **Payroll**
  As mentioned at the introduction of this chapter, paying employees is a central task of the HR function. This task, alongside the accompanying wage deductions and internal checks and balances, is the responsibility of the payroll department.

Some key features for SAP SuccessFactors Employee Central are as follows:

- **Foundation objects**
  The corporate data model includes the significant objects that define the organization (company code, business unit, division, department), pay, and job structures. SAP SuccessFactors is migrating foundation objects to become generic objects (in the metadata framework [MDF]) to make it easier to administer them.
- **Employee data**
  Importing and exporting data is done using downloadable templates that are defined by the data model settings. These are also now configurable.
- **People Profile**
  Based on the user's role, HR, managers, or employees can view and maintain people data based around blocks of information. The People Profile also includes a header that summarizes corporate information, name, location, email, phone number, and manager. This is supplemented by the quick card with the number of direct reports, team size, and a link to the Org Chart. From quick cards, different actions can be taken.

  An example of a People Profile can be seen in Figure 11.2.

- **HR transactions**
  Actions include add new employee, change job and compensation, global assignment, and so on. It's also possible to go to other functions such as manage time off or proxy as someone else. Event reasons are defined by actions as well.

Processes can be triggered by employees, managers, and HR with configurable business rules and workflows assigned. This allows for approvals and notifications to be sent to other groups, that is, manager, manager+1, payroll, and finance.

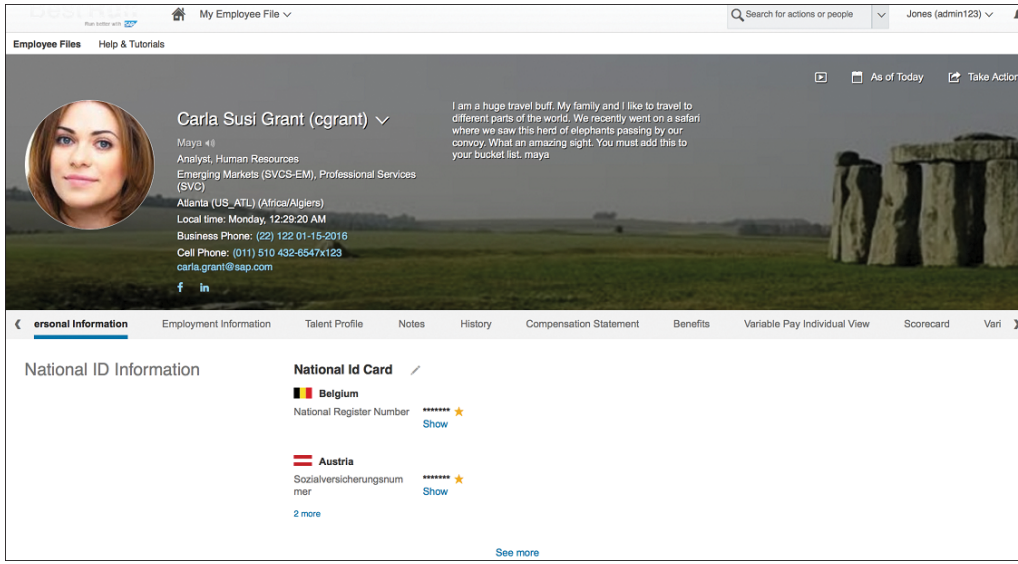

Figure 11.2 People Profile

- **Workflow**
  A few different types of workflow are available: dynamic roles workflows are transferred based on role type/area, and dynamic groups and users are sent to specific emails.
- **Pay structure**
  This defines the key elements that relate to payroll: pay group, range, grade, calendar, frequency, and pay components.
- **Proxy**
  There are two types of proxies:
  - Proxy on the behalf of: Open, view, edit, and send any item on behalf of the account holder.
  - Proxy as delegation: Complete admin tasks but not able to access private data.
- **Role-based permissions (RBP)**
  RBPs are made up of two parts:
  - Roles define the transactions and data scope that can be viewed/edited/deleted.

  - Groups are populations that are either included or excluded by criteria available from the data model.

- **Language**
  Language packs exist that display the fields in the language the person is logged on with. Translations can be changed on object names, texts, and labels. Three tiers—language, region, and variant—can also be configured.
- **Position management**
  Create, maintain, deactivate, and delete positions in either the position hierarchy, which is related to higher positions, or with the company structure, which defines the organization hierarchy. Assigning employees to positions allows the system to synchronize to their job record.
- **Org Chart**
  This visualization of the Org Chart (as shown in Figure 11.3) shows the employee/managers direct reports, peers, and managers above them. Actions can be taken from within the Org Chart similarly to the quick cards in the People Profile.

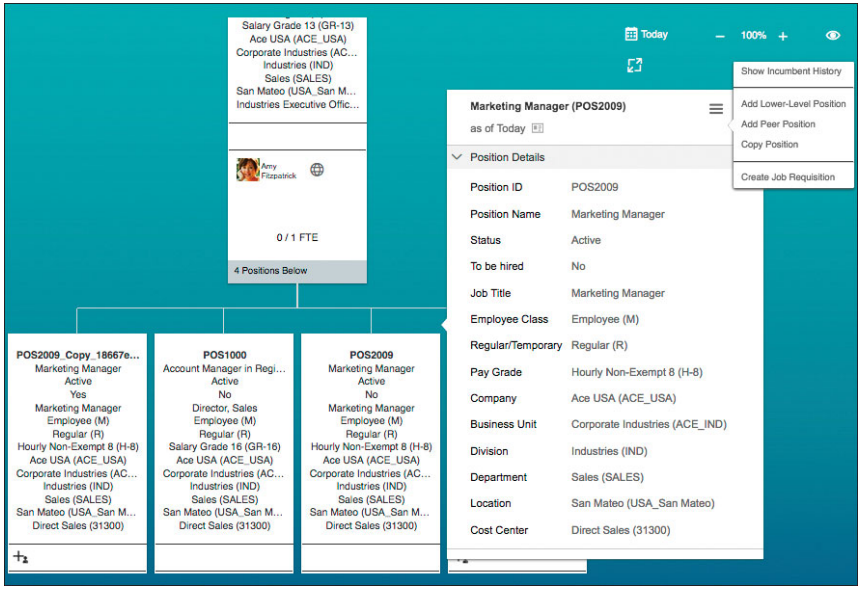

Figure 11.3 Org Chart

- **Global benefits**
  Benefit types can be defined by country, and enrollment is configurable to allow specific periods of selection or during other life events.

There are five distinct options available for integrating SAP SuccessFactors Employee Central to a payroll system:

- **SAP SuccessFactors Employee Central Payroll**
  This is SAP's hosted subscription cloud payroll. SAP includes upgrades in the contract but doesn't provide managed payroll service options. SAP provides at least 40 countries in their hosted option.
- **On-premise SAP Payroll Processing**
  More than 8,000 multinational and small- and medium-sized enterprise (SME) customers already run this global payroll as an on-premise solution, paying 80 million employees. There are 57 SAP country version payrolls with a further 42 partner countries.
- **SAP S/4HANA payroll functionality**
  The latest evolution of SAP includes a compatible on-premise global payroll based on SAP Payroll Processing.
- **Managed payroll**
  Several partners provide business process outsourcing (BPO) and managed payroll services that use the underlying SAP Payroll Processing solution.
- **Third-party payroll**
  Outsource payroll with BPO or another vendor.

Standard integrations are available for all of these options that link SAP SuccessFactors Employee Central to SAP Payroll Processing. These either use middleware (Dell Boomi or SAP Cloud Platform Integration).

11.4 Time and Attendance

A robust process for the management of time and attendance is crucial for a modern enterprise. There are a number of reasons for this:

- **Payroll**
  Employees are paid based on the work that they have done, so ensuring that this information is accurately recorded and available to the payroll department at the correct time means that employees can be paid on time, and employers can manage and forecast wages bills.
- **Legal requirements**
  Employers are required by law to adhere to various employment legislation often

concerning the amount a person can work and the minimum wage that a person can be paid for this work.

- **Accuracy**
  Managers need accurate time and attendance information to access performance and productivity and keep track of absence, lateness, and illness. An accurate record of an employee's time means that benefits and vacation days can be accurately calculated.

Together with the reasons just outlined, businesses today offer staff more flexibility than ever before. Attempting to manage travel and expenses effectively while simultaneously offering flex-time and mobile working poses significant challenges. In response, SAP SuccessFactors Employee Central provides the following two key functionalities for time and attendance:

- **Time off**
  Employees can request leave and other absences in the mobile app outlined in Figure 11.4. In common with other HR processes within SAP SuccessFactors, this request automatically kicks off a workflow that is then automatically routed to the appropriate manger based on the organization structure. Using the mobile apps (Figure 11.4), managers can also see a team absence calendar to check for conflicts and issues.

- **Time sheets**
  SAP SuccessFactors Employee Central provides a time sheet for employees to record their time based on duration (length of day; in hours and minutes) or clock time (start and end times). The method is either record exceptions to your planned working time (negative) with automatic approval or record attendance time and overtime (positive) in the weekly time sheet with approval by the manager.

  It's possible to assign view time valuation rules relevant for payroll to relevant time types and cost centers and then submit for approval. In addition, you can record on-call times, time off in lieu, and other allowances where permitted with approval required.

  Weekly time sheet approvals go to the line manager, who decides whether to approve them or not. They appear in the **To Do** tile under **Time Sheet Requests Waiting For My Approval** on the home page. **Approve** sends to payroll, and **Decline** sends back to the employee to make necessary corrections before resubmitting or add and post a comment for a clarification prior to taking action. Time can either be added via the desktop app or via the SAP SuccessFactors mobile app.

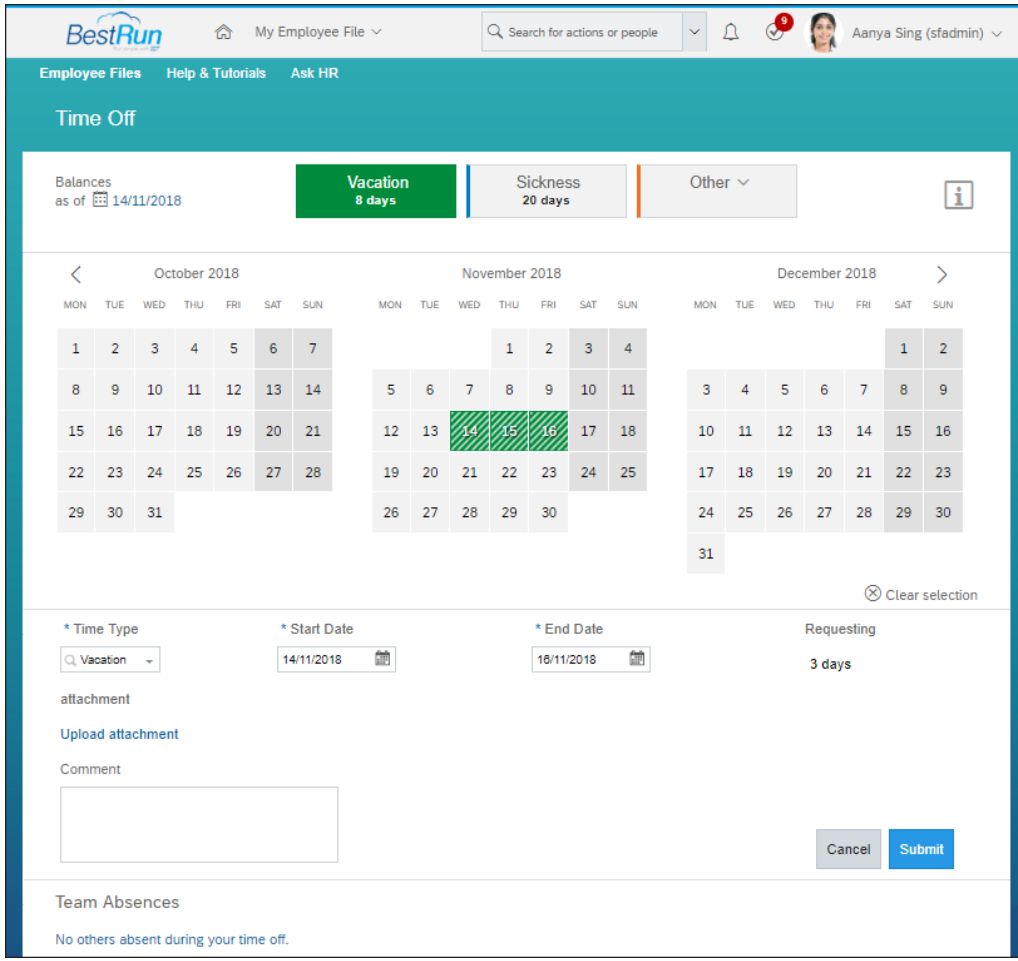

Figure 11.4 SAP SuccessFactors Mobile Application: Time Off Requests

11.5 Recruiting and Onboarding

An essential element in the HR cycle is the identification, engagement, and onboarding of new recruits. In a market where top talent candidates are well versed with a variety of job boards and hire processes, making the best first impression and capturing the attention and intrigue of a potential candidate is a valuable first step.

From an SAP perspective, this functionality is addressed through two solutions: SAP SuccessFactors Recruiting and SAP SuccessFactors Onboarding.

11.5.1 Recruiting

Find the best candidates for a job by first attracting and engaging with them using SAP SuccessFactors Recruiting Marketing and then use SAP SuccessFactors Recruiting Management (both subcomponents of SAP SuccessFactors Recruiting) to select the right person from the pipeline by screening and interview, make an offer, convince them to accept the offer, track at every stage, and ultimately onboard the new employee.

The general recruiting process can be described as follows:

1. **Define**
   A job requisition is created for a vacant position, allowing you to define the details of the role needed to recruit for.
2. **Approve**
   SAP SuccessFactors workflows, both dynamic and typical, allow for business approval of this role to be recruited, supporting both strategic elements for the business and compliance requirements.
3. **Source**
   Job postings will be published as defined either internally, externally, and on job boards or social media platforms, supporting your recruitment team in attracting potential candidates with ease.
4. **Search**
   Allows the recruitment team to search an existing pool of candidates from previous applicants to other roles.
5. **Apply**
   Candidates have the ability to apply directly to the role through the recruitment portal. A largely customizable landing page provides a first impression of your organization.
6. **Evaluate**
   Candidates can be evaluated against defined screening items, qualifying statements, and minimum requirements as part of the shortlisting process.
7. **Interview**
   Recruiting tools are available to support the interview process from room booking, call scheduling, and effective interview feedback and comment recording abilities within the module.

8. **Decision**
   The shortlisting activities as defined previously allow for the hiring manager to make a well-evaluated decision on the appropriate and successful candidate. These tools also ensure compliance with legislation for a fair recruiting process
9. **Offer**
   The offer process is also well supported within this module, allowing for negotiation and document iterations. Tokenized offer letters are populated with candidate and role information through data inputted at previous in-system recruitment steps, minimizing administrative delays that may jeopardize the successful hire of said candidate.
10. **Accept**
    Document signing tools again allow for a seamless and compliant acceptance of job offer by the candidate.
11. **Complete**
    Onboarding of the new candidate can now commence following a successful hire process.

The career site in SAP SuccessFactors Recruiting makes your company's vacancies searchable by search engines in one platform with multichannel job posting, social network integration, and mobile career sites. Search engine optimization (SEO) drives more traffic to job postings and engages passive candidates with the talent community when they sign up for alerts. The site includes a home page, 10 strategy pages, up to 4 company pages, an interactive map, and mobile features. The SAP SuccessFactors Recruiting dashboard shows which marketing strategies result in the best candidates, runs reports on budget costs, and shows time to fill positions information, site traffic, and visitor sources.

In SAP SuccessFactors Recruiting, vacant positions transfer to open job requisitions. Both internal and external job applicants are identified, screened, select, hired, and onboarded.

The **Talent Pipeline** screen shown in Figure 11.5 allows candidates to be moved through to appropriate stages and tracks the application process in an applicant's record.

A database of all candidates (internal and external) can be searched to forward on prospective applicants to requisitions. Interview Central helps manage the interview with calendar integration.

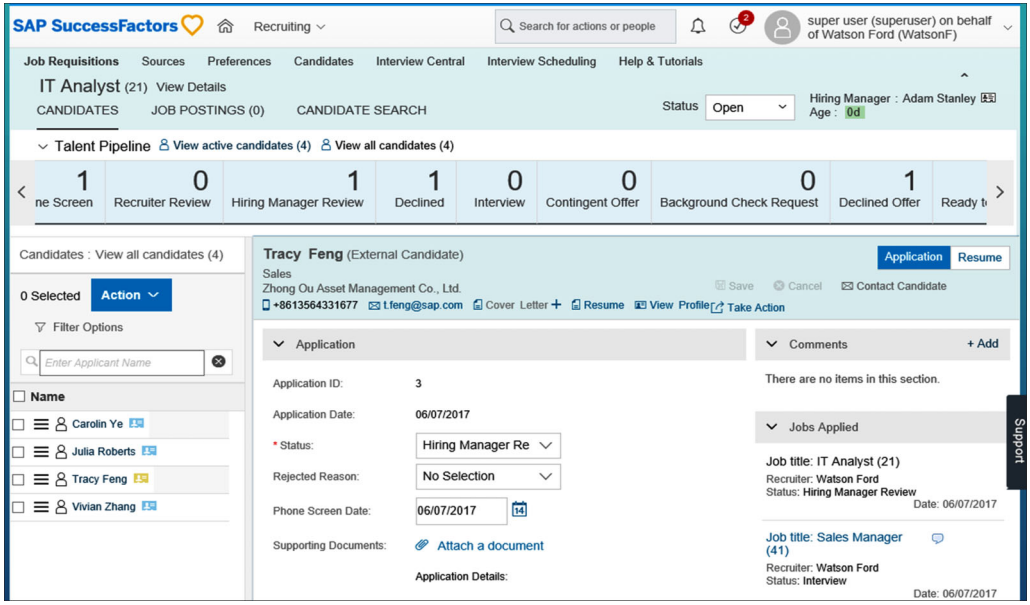

Figure 11.5 Talent Pipeline: Job Requisition

11.5.2 Onboarding

After your candidate has accepted the offer, your new hire can hit the ground running with SAP SuccessFactors Onboarding, which allows them to connect with their manager before day one. A common misconception is that after a candidate has been hired, the difficult job is done. However, a significant body of evidence suggests that how an employee is onboarded (engaged and merged into the company) is a significant factor in both the time it takes for the employee to become productive and also the employee's overall success in the business.

Sap SuccessFactors Onboarding facilitates this (connecting new employees with people and processes) and also provides the process to ensure that all corporate and legal compliance, including all paperwork, is completed.

Prior to the new hire joining the company, SAP SuccessFactors Onboarding provides guidance for new hires in terms of what their first day will look like together with giving them the ability to connect with new workmates and access any other relevant information. There is also an Onboarding mobile app, as shown in Figure 11.6.

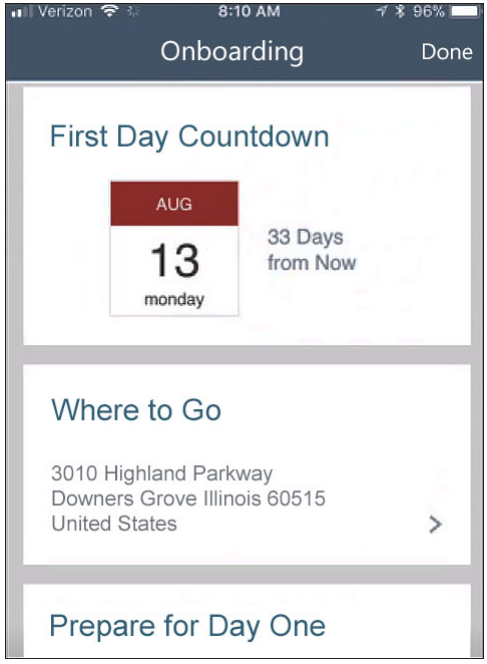

Figure 11.6 Onboarding Mobile App for New Hires

Sap SuccessFactors Onboarding provides wizards to walk hiring managers through the preparations for new hires. Figure 11.7 shows the easy-to-use dashboards that provide a simple way to track a formal onboarding process.

These are some of the activities they can perform using prehire temporary access:

- **Post-hire verification**
  Allow the company representative to confirm new hire job information, such as where they will work, salary, and so on.
- **New employee step**
  Guide the person through key onboarding information gathering not collected yet, including legal forms, bank details, emergency contact, and policies and procedure agreements.
- **Orientation step**
  Connect to the right people before starting and access content that's relevant to the job, including links to learning.

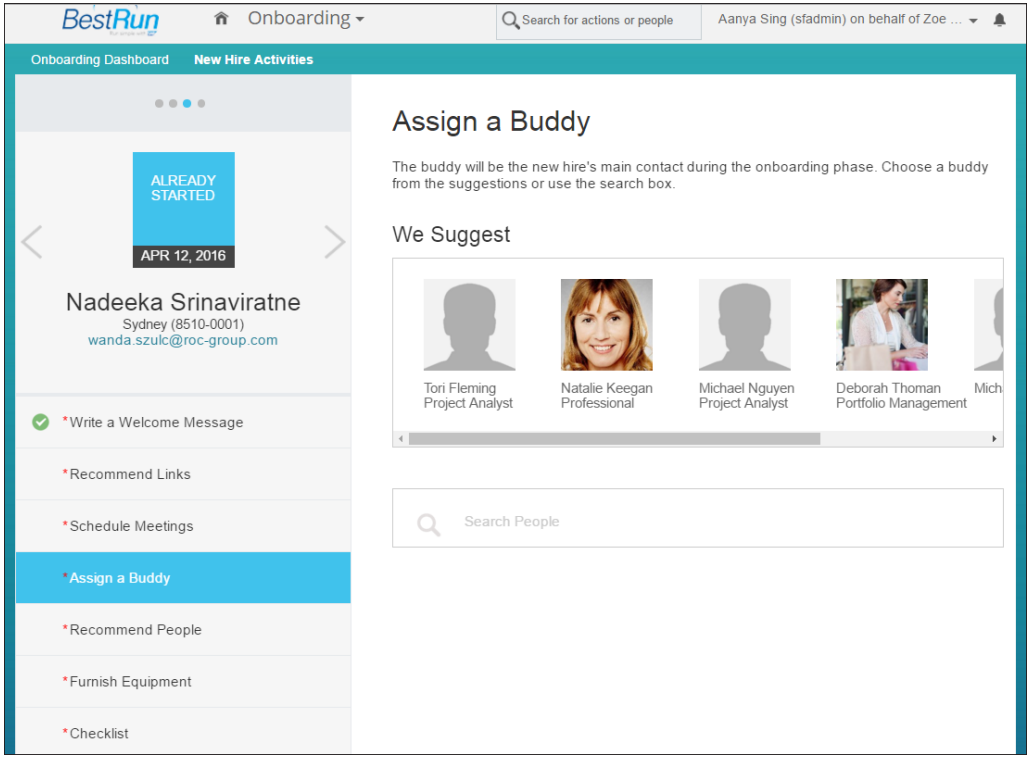

Figure 11.7 New Hire Activities

11.6 Learning and Development

Attracting talent is only the first step in the development of a content and suitably skilled workforce. Ensuring that each employee is engaged, has a defined career path, and is qualified and equipped with the skills needed to succeed is of paramount importance to both the employee and the employer. From an SAP SuccessFactors portfolio perspective, the functionality covering learning and development is provided by the following products:

- SAP SuccessFactors Learning
- SAP SuccessFactors Succession & Development

We'll now review each in more detail.

11.6.1 Learning

For the employee, at the heart of SAP SuccessFactors Learning is the home page that provides access to a learning plan, learning history, recommendations (based on machine learning capability), and access to all courses, including courses provided by external organizations (Figure 11.8). Together with formal learning through online and classroom-based courses, SAP SuccessFactors Learning also provides for social learning. Where learning groups exist for courses, individuals can find course content, engage in discussions, upload content, and collaborate.

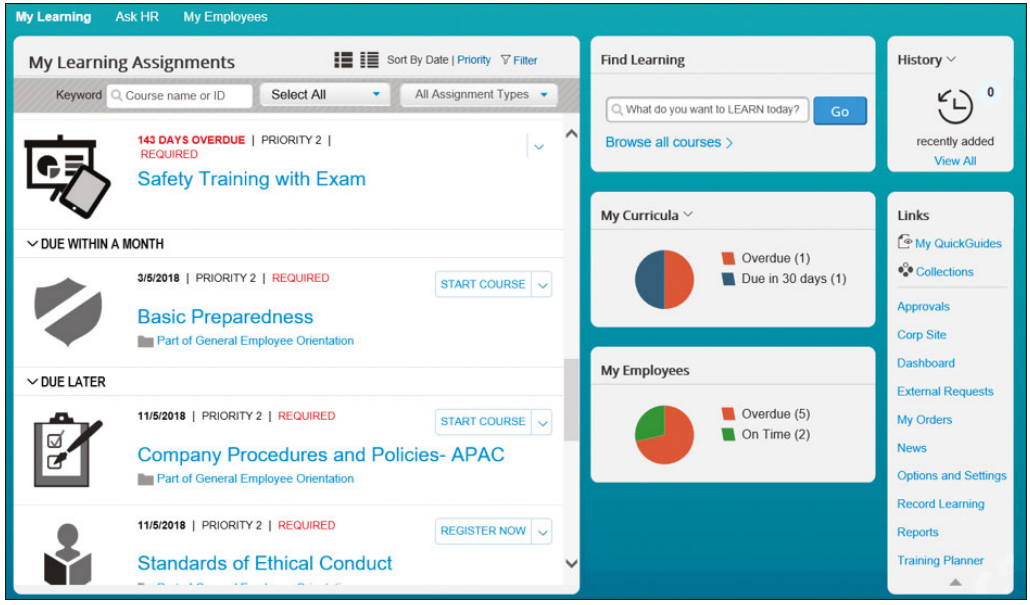

Figure 11.8 Learning Homepage

SAP SuccessFactors Learning can also be used to ensure that certification and mandatory training is assigned to individuals, completed, and tracked, helping to ensure compliance for the organization.

From an organizational perspective, SAP SuccessFactors Learning also provides analytics and metrics, such as training hours per full-time equivalent (FTE), and a breakdown of training activities by department or organizational unit.

Digital Disrupter

Today, many employees are required to do work on the go. As smart devices increasingly replace desktops, SAP SuccessFactors Mobile offers an array of learning functionalities:

- Browse course catalog, register/check-in for classes, approve enrollment, and review learning history.
- Launch online courses or download to a device to complete while offline.
- Expand learning by creating interactive QuickGuides.

In addition, instructors can manage learning courses, record attendance, and contact students via email.

11.6.2 Succession and Development

The need to cultivate the next generation of talent within an organization can create a distinct business advantage. When done well, it's a mutually beneficial scenario for both the organization and the employee. The employee gets the training needed to progress within the organization, and the organization benefits from engaged and efficient employees.

SAP SuccessFactors Succession & Development provides functionality to objectively access employee potential, which enables organizations to create scorecards in which individual employee competencies and skill levels can be assessed through the use of embedded tools. This allows organizations to quickly and accurately quantify and identify top (and bottom) performers and future potential using a configurable nine-box matrix.

Succession planning allows the organization to identify candidates for key roles and fill positions rapidly, allowing more accurate staffing decisions, increasing diversity, and retaining critical organizational expertise.

For succession planning, SAP SuccessFactors Succession & Development offers the following features:

- Succession plans can be created, nominating the most suitable candidates. Key indicators such as risk of loss, impact of loss, and bench strength can then be assigned.
- The **Succession Org Chart** and **Position Tile** view provide managers and HR an interactive display to graphically view the current status of a team or talent pool.

- A talent pool groups together several suitable successors for a particular job role.
- Talent search can be used to search the organization for the right successor.
- Presentation and calibration features facilitate discussion between managers and HR about the suitability of specific potential successors.

On the development side, SAP SuccessFactors Succession & Development allows employees to proactively explore career paths, assess readiness, and address skills gaps through targeted development plans. It also facilitates a dialogue about development activities while providing employees with feedback through ongoing coaching. SAP SuccessFactors Succession & Development also matches mentees with potential mentors to accelerate development.

11.7 Performance and Compensation

Many organizations adopt a pay-for-performance approach to compensation with many employees gaining a bonus if certain predefined objectives are achieved. This functionality is provided for in SAP SuccessFactors Performance & Goals and SAP SuccessFactors Compensation. In the following sections, we'll look at these two solutions in more detail.

11.7.1 Performance and Goal Management

SAP SuccessFactors Performance & Goals enables employees and managers to align individual goals with company business objectives so they are working on things that matter.

Some of the key features are as follows:

- The Goals Library contains more than 5 specific, measurable, attainable, realistic, and timely (SMART) goals.
- Managers can set cascading goals and see progress at all levels.
- Employees then maintain and link their goals with discussions with their manager to agree to them.
- Goals can be updated and reinforced with regular updates.

This leads to the performance management processes. The performance management process flow covers the following steps:

- HR admins launch the performance review forms.
- Managers request feedback from raters.
- Employee performs a self-evaluation.
- Managers rate and compare employee's competencies, and then perform their team's evaluations.
- HR admins create calibration sessions to calibrate employee performance ratings with managers.
- Managers conduct year-end reviews with their employees who subsequently sign off on their reviews.

For performance management, SAP SuccessFactors Performance & Goals enables the following:

- **Continuous performance management**
  Should be used to provide regular check-ins for quick feedback, review achievements, and frequent coaching advice from the manager to their employees.
- **Effective performance management**
  Involves an ongoing dialogue between the employee and manager, with clear expectations.
- **360-degree review**
  Helps organizations collect employees' performance from everyone, both inside and outside the company.

To transition to the compensation and succession process, you can use the Calibration tool. The Calibration tool is used to compare and potentially adjust ratings of team members to create standardized performance levels across the organization. It helps managers visualize objectively the distribution of their team ratings and to facilitate discussion about decisions. You can calibrate ratings using SAP SuccessFactors Performance Management, SAP SuccessFactors Succession & Development, and SAP SuccessFactors Compensation.

You can use the calibration dashboard, list, bin, matrix grid, or executive review views to do the following:

- Select data sources
- Select groups of employees to calibrate
- Discuss with management

- Adjust the ratings
- Publish back to the data source

11.7.2 Compensation

Distinct pathways exist to reward and retain high-performing employees. Using the pay-for-performance method, you can pay them accordingly based on their contributions to the business either to award salary increases in compensation management or bonuses and stocks in variable pay.

Let's take a closer look at each option, as follows:

- **Compensation management**
  The salary review process begins with budget preparation by the compensation specialist inputting company and economic indicators, defining eligibility criteria with salary surveys and merging these into cost plans. The budgets for merit increases and promotions are then fed into an approved compensation budget.

  Next the framework and guidelines are prepared, including the eligibility guideline matrix, using performance ratings and lookup tables where required. The framework is reviewed and approved by committee, HR business partners (HRBPs) are informed by a review process, and then the compensation worksheets are generated and released with the line managers being notified.

  The line manager then reviews and amends the team's proposals, and sends it for approval to his manager, who can then revert with comments or cascade the proposal upward. After the worksheets are all completed, then compensation statements can be generated, released to line managers for handover to employees, and published to their People Profile. Compensation adjustments trigger updates to employees' compensation info and job info records.
- **Variable pay**
  Like salary review, bonus starts with corporate and business goals key performance indicators (KPIs) being used to create a bonus plan design. Bonus is calculated using targets and history and letters created for distribution to line managers and employees. Next, variable pay worksheets are generated and sent to line managers for action, cascading up the hierarchy for higher manager approval. Bonus letters are issued to employees, and their compensation info records are updated.

11.8 Workforce Planning and Analytics

Workforce planning helps organizations ensure that they have the right people with the right skills both from an immediate and strategic view, whereas workflow analytics ensures that data pertaining to an organization's workforce is accessible and digestible. Both capabilities are available within the SAP SuccessFactors Workforce Planning and SAP SuccessFactors Workforce Analytics solutions, which contain the following features:

- **SAP SuccessFactors Workforce Planning**
  Two main components of workforce planning exist: strategic and operational planning. SAP SuccessFactors Strategic Workforce Planning looks at the long-term view of the organization and forecasts the roles that will be critical in the future. Operational workforce planning, on the other hand, looks at the immediate demands of the business and compares this with the current talent supply to define whether additional resources are needed.
- **SAP SuccessFactors Workforce Analytics**
  SAP SuccessFactors Workforce Analytics is designed to allow HR to quickly and easily understand all critical information pertaining to their workforce. Together with the ability to create and access reports, SAP SuccessFactors Workforce Analytics also contains hundreds of predefined best practice metrics, including the following:
  - Headcount
  - Learning
  - Recruitment
  - Financials
  - Turn over

  It also contains built-in benchmarks to allow organizations to compare themselves to peer organizations.

  The **Reporting** center within SAP SuccessFactors Workforce Analytics provides a single view for running and creating the following different types of reports:
  - Table (ad-hoc reporting): Templates allow for custom reports to be created and shared across the organization. A custom template can also be uploaded.
  - Canvas (online report designer): Build free-form reports by dragging and dropping report components such as tables and charts onto a canvas. The reports are exportable as PPT, PDF, Word, Excel, and email, and they are customizable,

allowing you to relabel fields, perform custom calculations and concatenate fields, hide duplicates, and transpose rows and columns.

- Analytics tiles and dashboards: Analytic tiles can be built using a simple click-through wizard. Combine tiles into dashboards or push tiles to home pages and mobile devices.
- Workforce planning: Perform demand and supply models, risk analysis, simulation, and what-if scenarios. Create and maintain a headcount plan for the organization with a budget for the plan and subplans. Get aggregated and detailed views monitoring progress with planned FTE across time and drill down into lists.
- SAP Analytics Cloud for SAP SuccessFactors: SAP SuccessFactors Workforce Analytics can be connected to SAP Analytics Cloud to blend with other sources of data to present SAP Analytics Cloud stories, including SAP Digital Boardroom presentations. We'll discuss SAP Analytics Cloud further in Chapter 16.

11.9 The Road Ahead

Despite announcing that support for on-premise SAP ERP HCM functions would be (in certain circumstances) extended until 2030, it's clear that the strategic HR solution within the SAP portfolio is SAP SuccessFactors.

The product vision is to transform the employee experience, enabling them to consume HR services and processes when and how they want them. Planned innovation proposals include the following:

- **Emerging technology**
  In line with the rest of the SAP portfolio, many of the upcoming innovations will resolve around the business application of artificial intelligence (AI) and machine learning with the goal of making ever more intelligent recommendations and providing a better user experience through the use of a digital assistant. Predictive analytics is also likely to feature in the future of SAP SuccessFactors with the introduction of a smarter candidate search facility.
- **Additional capabilities**
  From a functionality perspective SAP SuccessFactors is looking to roll out additional capability in the form of pay-gap analysis, pay equity correction, and anonymous recruiting.

In the next chapter, we'll move onto a slightly different HR process—contingent workers with SAP Fieldglass.

Chapter 12

Contingent Workforce Management with SAP Fieldglass

The purpose of this chapter is to introduce one of the newest members of the SAP portfolio: SAP Fieldglass. We'll discuss how a shift in the nature and composition of the modern workforce has necessitated SAP to extend its portfolio into an area for which it didn't previously cater.

SAP Fieldglass represents a reaction to the seismic shift in the nature and composition of the workforce of today's modern enterprise. Traditional employment refers to individuals who are permanently engaged by the organization for whom they provide a service under a contract of employment and who hold the recognized rights and duties safeguarded by the law.

However, a "new normal" has evolved where contingent workers make up an ever-increasing percentage of an enterprise's workforce. Contingent workers, despite being know by a multitude of other labels, such as external workers, contractors, and flexible labor, have one consistent unifying factor—they aren't traditional waged employees of the company for whom they are providing a service.

The rise of the contingent worker promises a greater degree of agility, better cost control, and access to talent for a business, but it also brings specific challenges. The emergence of the contingent workforce created a problem for both industry and SAP. Many businesses struggle to answer simple questions such as, who are their contingent workers, where are they located, and how much are they spending on them?

To bridge this gap, in 2014, SAP acquired Fieldglass, a software-as-a-service (SaaS) solution that provides a process for managing the entire contingent labor lifecycle from the initial job request creation, recruitment, and onboarding through to invoicing and finally offboarding. In short, it provides both the HR and procurement elements required to effectively control contingent labor, which are missing from SAP

SuccessFactors and SAP Ariba. Through the combination of SAP SuccessFactors and SAP Fieldglass, organizations can perform total workforce management, while total spend management is achieved through SAP Ariba and SAP Fieldglass. Figure 12.1 shows SAP Fieldglass within the SAP landscape.

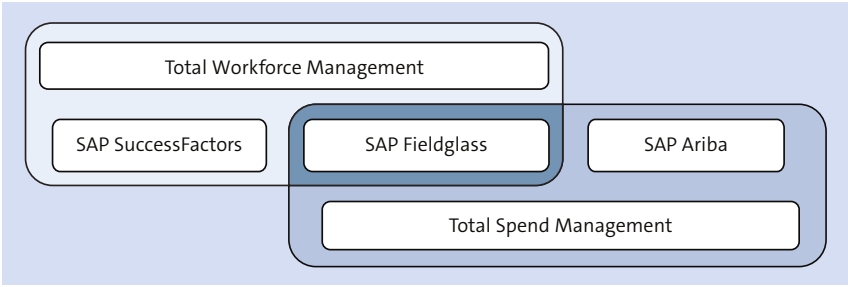

Figure 12.1 Complete Workforce Management in the SAP Portfolio

Out with the Old

Confronted with an ever-increasing market, SAP was faced with a problem, specifically that its current functionality failed to effectively provide businesses with the requisite agility to leverage nonwaged workers either from an HR or overall spend perspective.

SuccessFactors provided a business with the capabilities to deal with traditional waged workers and Ariba had the ability to cater to direct and indirect material purchases but struggled to deal effectively with the full lifecycle of service sourcing and procurement.

The rational for SAP acquiring Fieldglass appears to be twofold. First it was to fill a gap within the functionality that the software giant provided, and second it was a strategic investment into the SaaS cloud model.

In this chapter, we'll investigate further into the subject and evolution of the contingent worker force before outlining the services offered by SAP Fieldglass, which seek to overcome the problems that this new employment model poses for organizations. However, before we do, let's see how this shifting landscape has affected our business case.

12.1 Business Case

In line with many organizations, Bault Robotical has in the past decade moved from a model whereby its work was performed almost exclusively by employees to a scenario where much of its work is now performed by nonemployed or "contingent" labor. Indeed, this evolution in Bault Robotical's workforce has mirrored a global shift, which, according to research, has seen two-thirds of organizations actively reshaping its workforce to combine traditional payrolled employees and contingent workers.

The workforce within Bault Robotical comprises a diverse collection of talent, including freelancers, independent contractors, and "gig"/agency workers who provide the organization with the flexibility to increase supply whenever fluctuating demand necessitates it. By tapping into the contingent labor market, Bault Robotical can quickly dial up the workforce when required without incurring the financial overhead associated with traditional employees when demand reduces.

Together with the use of agency or gig workers, Bault Robotical also uses a significant number of external service providers to perform specific, discrete pieces of work. For example, they use specific consultancies to implement software such as SAP S/4HANA.

While providing flexibility for Bault Robotical, the growth in contingent labor has caused a number of issues. The main reason for this is the fact that the administration of contingent labor doesn't fit neatly into the jurisdiction of a single department within Bault Robotical and is rather caught between HR and procurement. The consequence of this is that the administration of the contingent labor processes neither fits neatly into either HR functionality within SAP SuccessFactors or procurement functionality within SAP Ariba. For example, traditional HR processes and systems are geared to the management of employees while the procurement processes are focused on the purchase of services but don't consider the administrative stages of the onboarding, offboarding, and so on. In reality, the required business processes that form the management of contingent labor were often managed offline and in solutions such as Excel within Bault Robotical.

As part of the Bault Robotical business transformation in this area, it was decided to both change the internal organizational structure of how contingent labor was administrated and to introduce SAP Fieldglass to manage the end-to-end process. From an organizational perspective, Bault Robotical decided to engage a managed service provider (MSP) to coordinate the myriad of agencies and consultancies that

provided the contingent labor force to Bault Robotical. The SAP Fieldglass solution provided the overlay and integration between Bault Robotical and the MSP, which allowed Bault Robotical to request labor as and when required and gave the MSP the requisite visibility and control to administer these requests. Furthermore, SAP Fieldglass provided the subsequent communication channel between the MSP and agencies for formal controlled communication.

12.2 Simple Contingent Work

There are two categories of contingent labor that are divided under the labels of simple contingent work and complex contingent labor. Figure 12.2 attempts to characterize these two contingent labor types along with some of the characteristics of each.

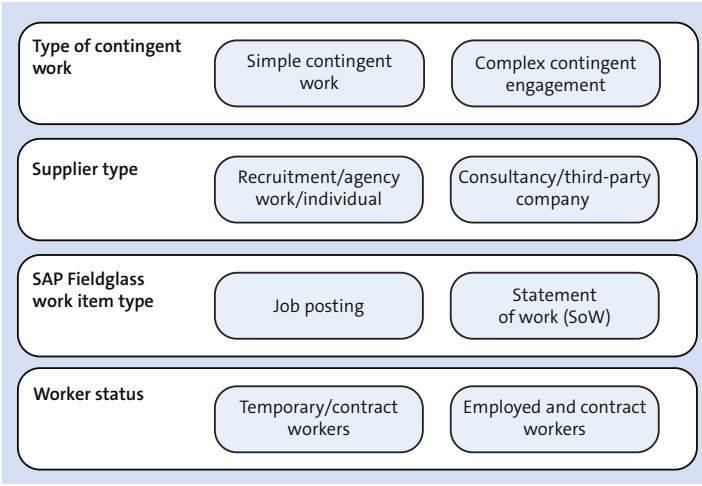

Figure 12.2 The Two Main Catagories of Contingent Labor

Simple contingent work is perhaps the scenario that most people think of when considering contingent labor. It's where an organization takes on extra workers principally to provide additional capacity and or capability (e.g., in the warehouse or the shop floor).

In practice, however, rather than contract directly with each individual worker, an organization will generally use suppliers such as recruitment consultancies and agencies who act as a central point of coordination, sourcing staff and managing the

commercial relationship with each worker. This dramatically reduces the administration and time required from the engaging organization. Figure 12.3 shows that although the worker provides a service to the company commercially, the relationship is between the company and the agency and the agency and the worker.

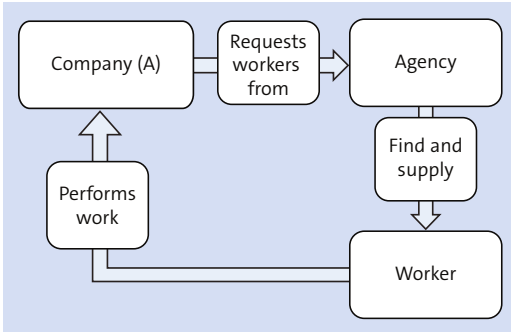

Figure 12.3 Simple Contingent Work Request Flow

Figure 12.4 shows the workflow breakdown of SAP Fieldglass by three key phases.

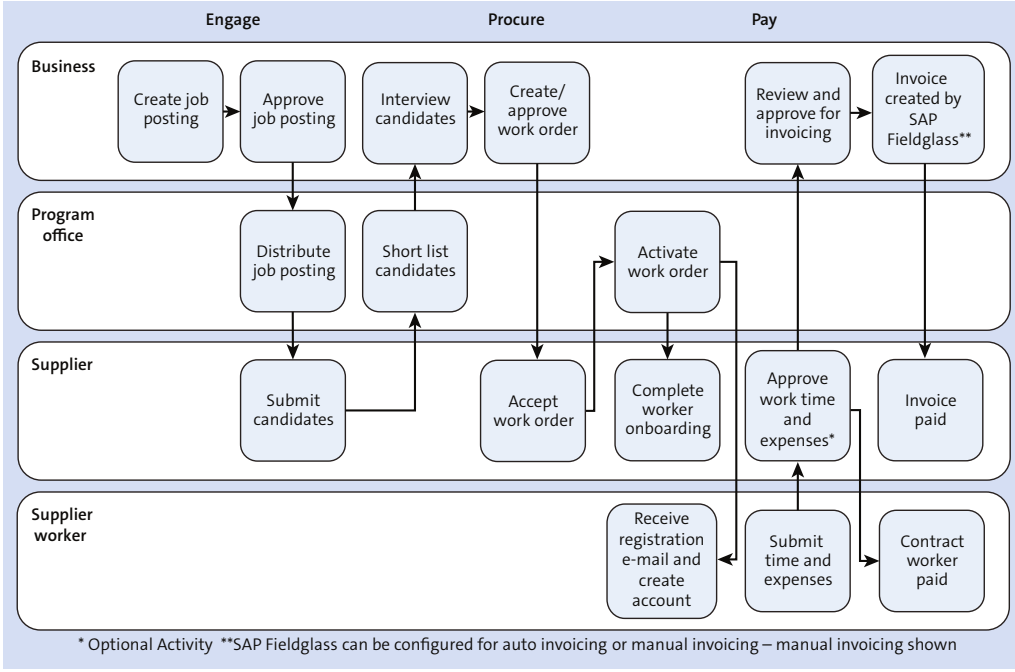

Figure 12.4 Simple Contingent Workflow in SAP Fieldglass

We'll now break this functionality down and take a look at the key phases, as follows:

- **Engage**

  The SAP Fieldglass work item that triggers the simple contingent work process is the job posting, which outlines the skills of the persons required. This job posting is created within SAP Fieldglass, and after any necessary internal approvals, the job is distributed by the program office to a preferred supplier base of agencies who are maintained within SAP Fieldglass. The program office is either staffed with internal resources or outsourced to a third party, such as an MSP or a vendor on premise (VOP). Whatever option is chosen, the program office then becomes the vehicle to ensure that the correct type of talent is hired for the approved job posting.

  Once issued by the program office, the job posting is visible (together with any other requirements) to each agency within the **Work Items** icon of SAP Fieldglass.

  Upon clicking on this item, the full work order item list is displayed (as shown in Figure 12.5).

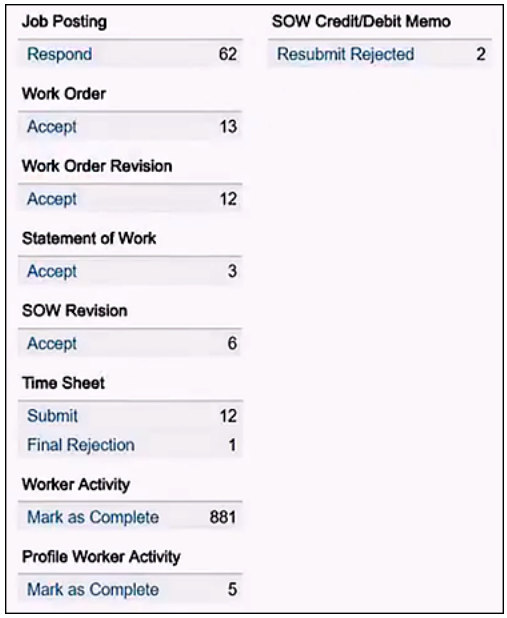

Figure 12.5 Work Order Item List in SAP Fieldglass

Agencies have the option to accept or reject this job posting together with providing a reason for any rejection. Assuming the request is accepted, then the agencies

will identify suitable candidates and submit details and CVs through the job posting on SAP Fieldglass. Once received, CVs are evaluated and interviews held. SAP Fieldglass allows for this submissions to be reviewed either on the desktop or via the Fieldglass mobile app and allows the program office to compare candidates and schedule interviews through the single touch of a button.

- **Procure**
  After candidates have been selected, a work order is created in SAP Fieldglass by the requestor, accepted by the agency, and activated by the program office. At this point, and assuming that all the relevant worker data has been entered into SAP Fieldglass, the system will send a registration email to the worker that will enable the worker to create an account in SAP Fieldglass, which is required for the subsequent entry of time and expenses. During this process, the onboarding process should have been completed, which is once again managed by SAP Fieldglass (see Figure 12.6).

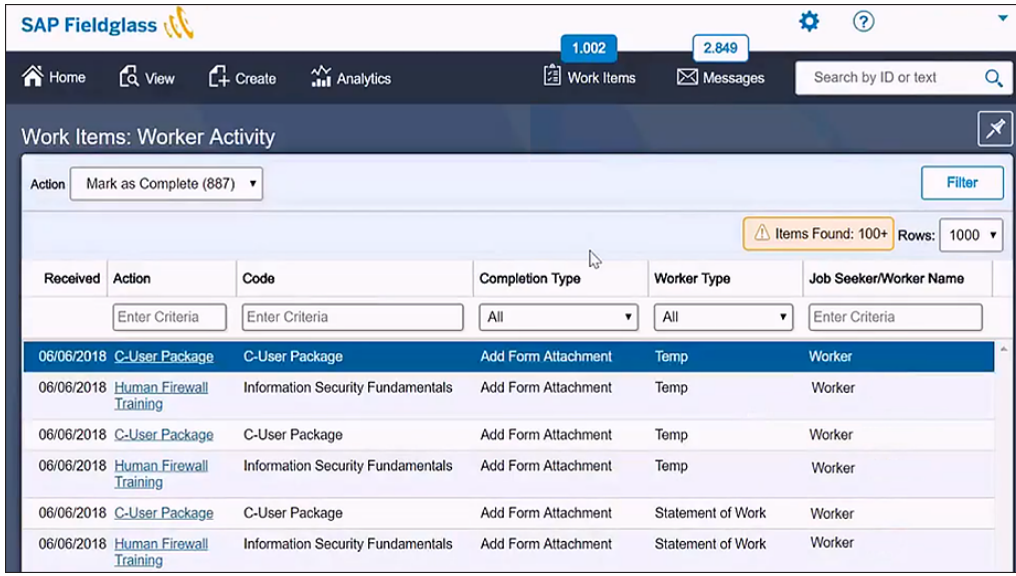

Figure 12.6 Onboarding Activity in SAP Fieldglass

- **Pay**
  On a periodic basis, such as daily, weekly, or monthly, the worker with complete a time sheet in SAP Fieldglass that outlines the number of hours worked (Figure

12.7). Before submittal, the agency may decide to check and approve the time entered by its workers.

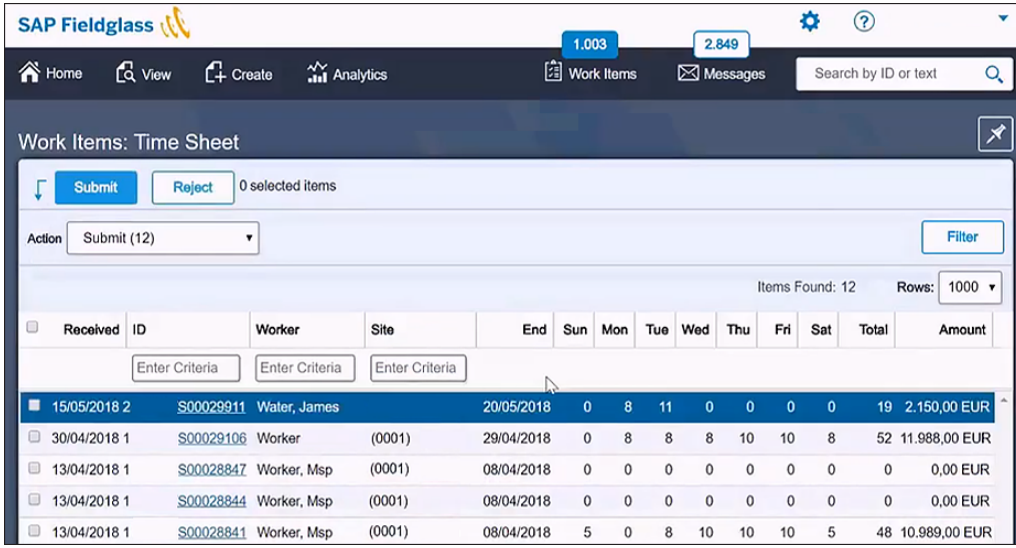

Figure 12.7 Time Entry in SAP Fieldglass

After the time sheets have been entered, validated by the agency, and approved by the customer organization, then an invoice can be automatically (or manually) created and processed for payment.

12.3 Complex Contingent Engagements

The second category of contingent labor is complex contingent engagement, which refers to work that is performed by an organization such as a consultancy or third-party service organization and is generally contracted within a framework of deliverables known as a statement of work (SoW). The workers who actually provide the service may be independent contractors or employees of the third-party organization, but either way, they are providing a service that fulfills the obligations within the SoW. An example of this is an SAP consultancy that is contracted by a company to implement SAP S/4HANA. Here, as shown in Figure 12.8, the contractual relationship is between the company and the third-party vendor, with the consultants often (but not always) employed by the vendor.

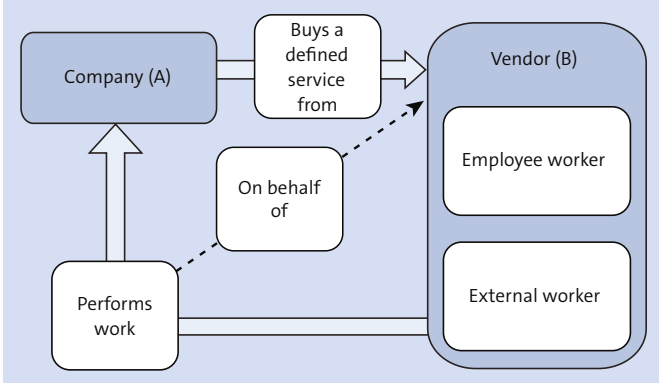

Figure 12.8 Complex Contingent Engagements Request Flow

Processing complex contingent engagement SoW requests through SAP Fieldglass has many similarities with the previous scenario. Figure 12.9 shows the workflow, broken down by the same phases.

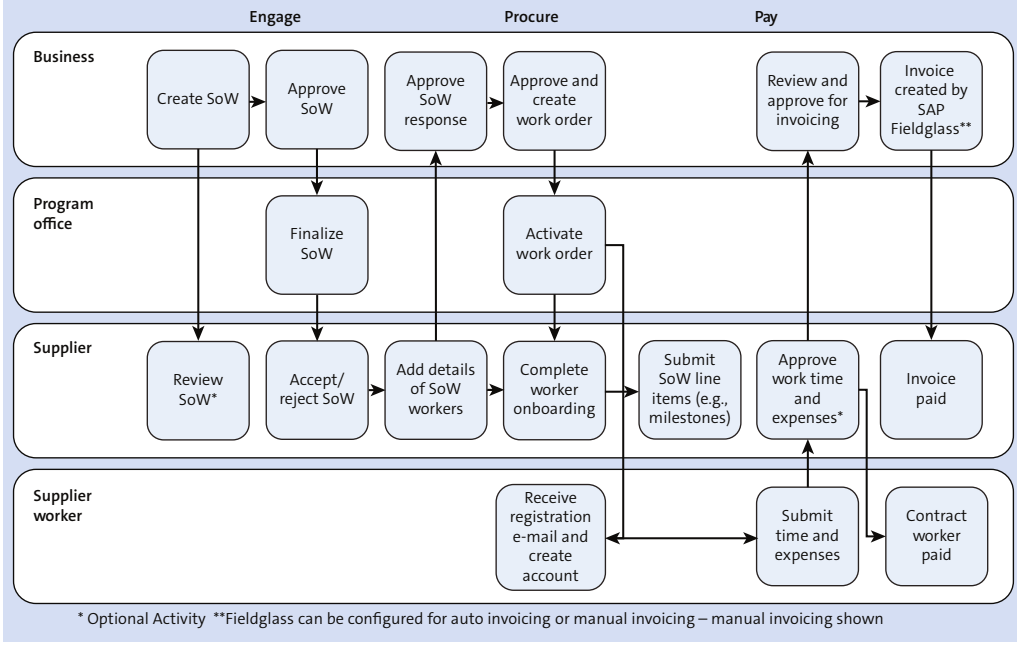

Figure 12.9 Complex Contingent Workflow in SAP Fieldglass

The principle differences are concerned with the processing of the SoW, shown in Figure 12.10. The SoW is in effect a more complex version of the job posting and can be shared with one or more suppliers prior to the finalization. Initially, the SoW document is created in SAP Fieldglass and provides the service requirements to the requisite suppliers in a standardized format. The SoW can be created either from a predefined template or by copying previously used SoW documents. SAP Fieldglass contains a mechanism for internal collaboration to ensure alignment on requirements, and, once agreed on, this is then approved by a manager.

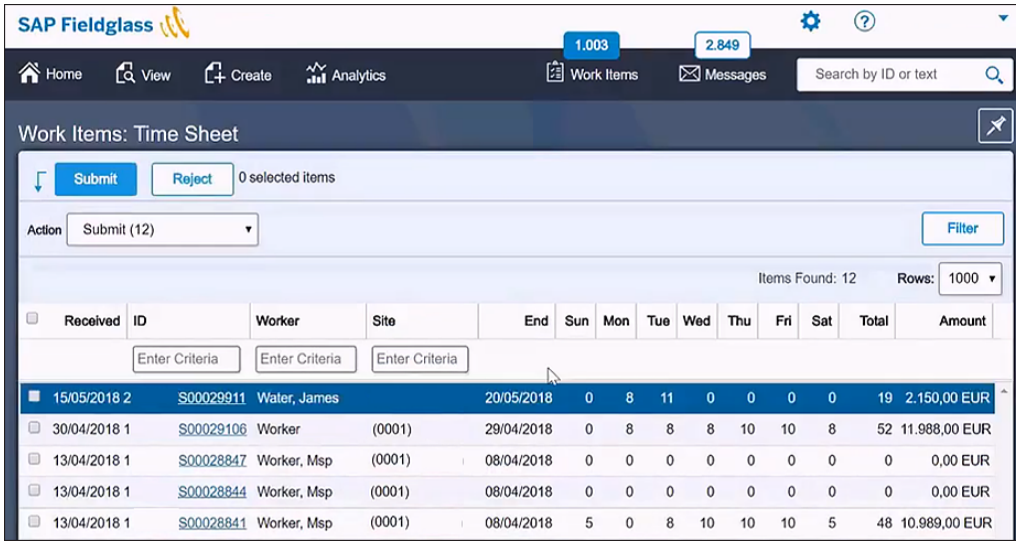

Figure 12.10 SoW Example in SAP Fieldglass

Once approved, the SoW is passed to the project management office which facilitates the communication to the identified third parties. As in the previous scenario, the receiving supplier will see a new item within SAP Fieldglass; this time it's a **Statement of Work** work item.

The SoW will contain the relevant details regarding the work that is to be performed and the rules pertaining to the SoW itself; again, the organization can decide to accept or reject the SoW.

After the receiving supplier has responded to the SoW, the process continues in a similar fashion as the first scenario.

12.4 The Road Ahead

The history (and success) of SAP Fieldglass has been based on its ability to solve the problem of contingent labor for large enterprises. However, recently, the portfolio has been diversified and released as a solution aimed directly at medium-sized businesses.

The rationale for this is based on an expectation that in tandem with larger enterprises, the percentage of the workforce that will be contingent in nature will swell from 35% (in 2016) to more than 50% in the next few years.

SAP Fieldglass Flex edition is built on the same cloud technology platform as its big brother, however, it comes preconfigured. An organization deploys SAP Fieldglass Flex using a self-service setup process that SAP says will enable an organization to use the solution without the help of other IT resources.

Together with investing in new models, SAP Fieldglass also remains committed to providing new services and functionalities for its enterprise edition. In the future, SAP Fieldglass intends to develop additional services that will be embedded into the service; a key strand of this is the development of chatbots that recognize, guide, and support users.

SAP Fieldglass also covers the requirements of local labor laws and work practices around the globe. Its advanced global tax framework enables customers to meet local tax requirements around the world and supports more than 20 languages having recently added Hebrew with right-to-left display support. The future will only see a further extension in the geographic coverage of SAP Fieldglass with more coverages for additional languages and local tax scenarios.

As a member of the SAP family, SAP Fieldglass, like SAP S/4HANA, SAP Ariba, SAP SuccessFactors, and SAP Concur, is starting to see functionality powered by SAP Leonardo. Currently, SAP Fieldglass has SAP Fieldglass Live Insights, which is a data-driven insights service that uses machine learning to add an extra dimension to the insights it provides. Again with other SAP Cloud Platform products, SAP Fieldglass has also announced the integration with SAP Analytics Cloud.

Moving forward, SAP Fieldglass will continue to harness SAP Leonardo to drive new capabilities to give customers insights at speed. One example is CV/résumé matching, enabled by machine learning, which will help streamline the recruitment process.

Hopefully this chapter has provided an insight into the emergence of the contingent workforce and how one of SAP's recent acquisitions—SAP Fieldglass—fills a gap in legacy SAP functionality. In the next chapter, we'll continue to focus on recent acquisitions by looking into SAP Concur and discussing the business processes that it's designed to simplify and transform.

Chapter 13

Travel and Expense Management with SAP Concur

This chapter introduces SAP Concur, a recent addition to the SAP portfolio. We'll discuss why SAP acquired Concur and explore the functional gap that Concur was acquired to fill.

In the previous chapter, we highlighted the role of SAP Fieldglass and discussed how this technology had been born as a reaction to a new set of business requirements (the contingent workforce). Conversely, in this chapter, we'll concentrate on the need to reimburse workers for business expenses incurred and to ensure compliant business travel—a necessity that has long been a staple of organizations across the globe. In this chapter, we'll discuss two intertwined business processes; time management and expense management while also looking at SAP Concur, the recent software-as-a-service (SaaS) addition to SAP's portfolio that is intended to cater for the travel and expense (T&E) requirements of the modern enterprise.

Despite being a relatively new addition to the SAP portfolio, Concur is a global leader in the business T&E management market having started in 1993. While initially focusing on the management of the expense process (now called Concur Expense), its reach has now extended to encompass the entire T&E management process. To achieve this, it both acquired and developed further modules such as Concur Travel, which serves as an online booking platform; Concur Request, which is used for pretrip approvals; and Intelligence, which provides advanced analytical content from data drawn from the other modules. It has also recently branched out into invoice processing (Concur Invoice), although this isn't discussed in detail within this chapter.

Out with the Old

However diligent the user may be, with a traditional paper-based process, there is always a lag between the expenses being incurred and the claim being submitted. This creates a problem for both the individual who has incurred the expense (but

hasn't yet been remunerated) and for the organization that is trying to track and control spend. Practically, it's very difficult for an individual to fully understand whether or not the expense falls within the parameters of the company's expense policy or not, a situation which can lead to either companies paying expenses that are outside of their defined policy or leaving employees disgruntled when the claim isn't fully met. In short, not only are these mundane tasks unpopular for the employee, they are also collectively costing organizations huge sums of money in terms of lost productivity.

SAP Concur is currently sold within three packages that contain differing functionality and/or support:

- **Standard**
  The standard version is aimed at smaller organizations that require limited functionality. At time of writing, the standard version isn't available in all locations but is available in the United States, United Kingdom, and Australia.
- **Professional**
  The professional offering includes a much more extensive functional scope together with a much higher degree of customization. This version is aimed at mid- to large-size enterprises.
- **Premium**
  The premium solution offers the same scope and configuration options as the professional offering but comes with a more comprehensive service around implementation. While the professional service is configured remotely, the premium service involves on-site appointments, and unlike the professional solution, the premium service also comes with a test instance and allows for a greater degree of customer amendments.

We'll explore the major T&E business processes further in the following sections, after taking a look at our business case.

13.1 Business Case

Like most multinational organizations, employees from Bault Robotical often need to travel for work. This may be in the execution of billable work that can be recharged to a client or in nonbillable situations, such as attending conferences and seminars.

In common with most organizations, Bault Robotical has an expenses policy that defines what the company will and won't pay for together with a set of financial limits for specific items; for example, the company will pay $100 per night for hotels or 40 cents per mile if an employee travels in his own car. In practice, the process involves employees paying for items and later claiming them back in the form of expense claims.

Prior to the introduction of SAP Concur, this meant travelers incurring the cost, keeping a paper-based receipt, and manually filling out expense reports together with sending in the accompanying physical receipt. This was a time-consuming task that was fraught with potential issues, such as the risk of losing receipts and the complications of people submitting receipts late and often en masse at month-end and year-end. As part of its program of transformation, Bault Robotical decided to implement SAP Concur to streamline the expense process for both the employee who incurs the expenses and also the finance department that processes the expense and has to accurately plan and budget costs.

While evaluating SAP Concur for expense processing, Bault Robotical also decided that some the additional functionality offered by SAP Concur could also help streamline the travel management process. Specifically, Bault Robotical saw a significant advantage in allowing travelers to book their own travel through the SAP Concur booking platform, knowing that flights, hotels, cars, and so on chosen were compliant with company policies and booked with the benefit of Bault Robotical company discounts.

Alongside Concur Travel, Bault Robotical also found that Concur Request, which deals with travel-related approvals, helped to fulfill a specific requirement relating to the need for additional approvals and information when a traveler was traveling overseas to a country deemed as "high risk." As Bault Robotical has a significant field service force, this is a common occurrence, and Bault Robotical has historically found this process hard to administer.

The final component of SAP Concur implemented was Concur Locate, which is used by Bault Robotical to provide pretravel advisory information and risk analysis for its employees who are traveling.

Together with the specific SAP Concur solutions, Bault Robotical allows its users to consume the service both from a desktop-based URL (see Figure 13.1) and the mobile application (see Figure 13.2) to make T&E processes easier to manage whether at home or on the plane.

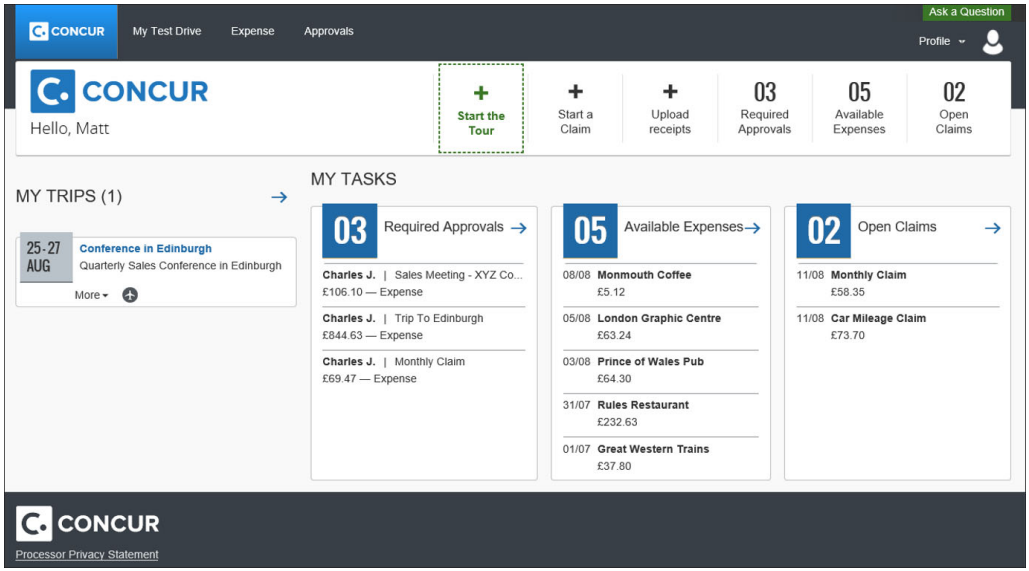

Figure 13.1 SAP Concur Desktop Home Page

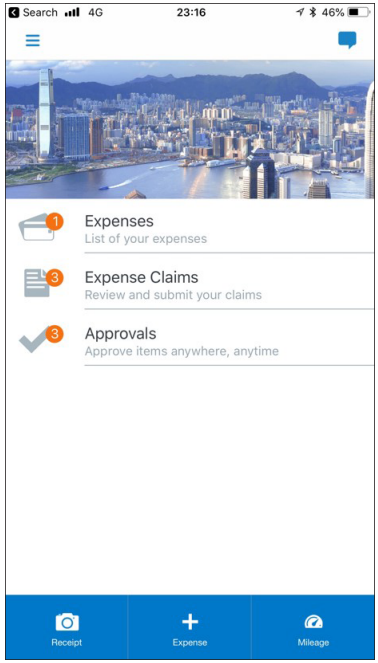

Figure 13.2 SAP Concur Mobile Application Home Page

13.2 Expense

Before we detail the key capabilities of SAP Concur, let's start by investigating further what constitutes the traditional expense process from a business perspective. As shown in Figure 13.3, the process begins with the purchase of something that an individual has paid for on behalf of a company or during the execution of work, and the process ends with the company in question paying back the individual. The process is common to all types of organizations, regardless of size, location, or sector and frequently includes expenses related to hotels, meals, trains, books, mileage, and other common (and less common) examples.

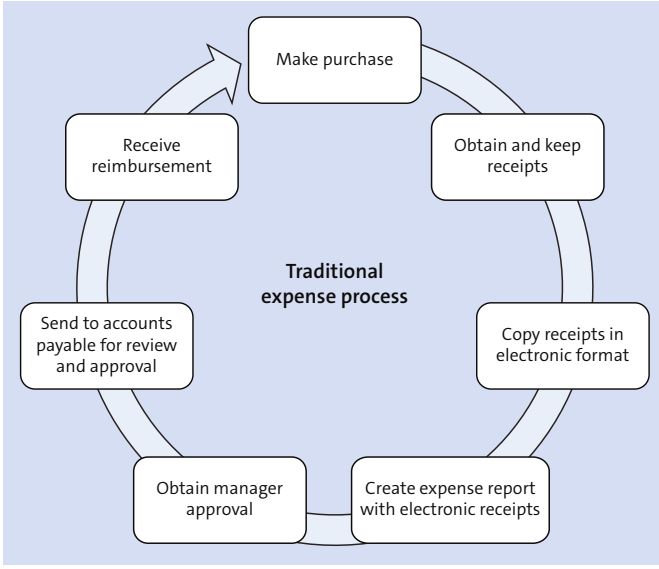
Make purchase
Obtain and keep receipts
Copy receipts in electronic format
Create expense report with electronic receipts
Obtain manager approval
Send to accounts payable for review and approval
Receive reimbursement
Traditional expense process

Figure 13.3 The Expense Cycle

Set against this process, organizations will generally also have an expense policy that outlines rules and guidance on what the organization considers to be "reasonable" expenses and under what criteria reimbursement will take place. For example, a company may dictate that a hotel should cost less than a certain rate per night or that an evening meal is reimbursable up to a set amount. Part of the back-office process is to ensure that the expense claim is compliant with the company policy and that the expense matches the corresponding submitted receipt.

In the following sections, we'll walk through the major steps of the expense process and discuss how each is facilitated by Concur Expense.

13.2.1 Making a Claim

If you've ever incurred a significant number of work-related expenses, you'll have had at least one situation where your wallet or purse was cramped with paper receipts. The receipt is the de facto proof that the worker actually incurred an expense—evidence that is needed both by the reimbursing organization and also government bodies who are looking to ensure compliance with taxation arrangements. However, in recent years, both organizations and many governments have changed their stance on paper-based receipts, allowing for photographs instead of physical copies. This together with the proliferation of mobile phones with cameras means that, for many, the process of capturing receipts can now be significantly simplified. In addition, by taking phots of receipts at the point in time they are obtained means that the chance of them being lost or destroyed is also greatly diminished.

Concur Expense is available both as an app that users can download from Google Play and the Apple App Store and as a desktop version that can be accessed via URL. In the app, the user can record an expense by photographing the receipt and adding the specific detail, such as the supplier, amount, and any other information dictated by the organization's expense policy.

Together with the ability to capture individual receipts and converting these into expenses, Concur Expense also allows for these individual expenses to be grouped together easily into one or more expense reports. This together with integration with corporate credit cards allows for expenses and expense reports to be quickly created and then electronically submitted to the relevant approver, greatly reducing the overall time taken to submit reports. Along with being a benefit to the individual who has incurred the expense, it also decreases the likelihood of clustered or late expense claims, which can provide a tangible benefit to finance and financial processes, such as the period close.

13.2.2 Approving a Claim and Reimbursement

Together with Concur Expense digitizing the experience for the submitter, it also streamlines the process for the approver and the person who subsequently processes and pays the claim. With a paper-based system, small things such as being away from the office can delay the approval process, and the effort needed to administer a paper-based claim means that often more time is spent entering the submission into the expense system than the value-added activity of validating the claim from a compliance perspective. This approach also means that when approving a claim, there is

a reliance on the approver to know, understand, and apply the correct company expense policy prior to approval. In reality, this often leads to managers approving what looks reasonable rather than what strictly adheres to company policy. In turn, claims that deviate from company policy are erroneously approved, or the error is pushed farther down the process, where rectification requires a greater degree of effort.

Concur Expense, however, applies and monitors adherence to company policy at the time the expense is captured. The application notifies the employee that there has been a policy infraction and requires the entry of a justification. This justification is passed to the approver upon submission to be used as mitigation when considering whether to accept the claim. SAP states that by highlighting when claims are noncompliant and providing mitigation justifications, approvers query far fewer claims, and the subsequent approved claims are far more compliant with policy that those submitted through paper-based systems.

As we've already seen, a traditional paper-based expense process involves a significant degree of nonvalue-added time and effort, from the authoring of the claim through to its approval. However, it's also estimated that once approved, paper submissions take on average nine days for the reimbursement monies to reach the bank account of the submitter. The somewhat counterintuitive rule also seems to suggest that the larger the organization, the longer the reimbursement payment takes. SAP Concur automates payments, and it's claimed that companies that use Concur Expense take on average four days to perform the corresponding reimbursement. Part of the reason for this includes the expedition of error processing whereby errors, such as incorrect bank details, are sent directly to the relevant employee for rectification.

13.2.3 Additional Functionality for Concur Expense

The following section outlines some additional functionality and services that can be procured and provide additional functionality to Concur Expense users, as follows:

- **ExpenseIT**
  This standalone application available to Concur Expense users provides the functionality to automatically turn captured photographs of receipts into expense items in SAP Concur. Using optical character recognition (OCR), the application prepopulates the SAP Concur expense item from the captured image. ExpenseIt also provides OCR functionality for electronic documents that are emailed to a specific SAP Concur email addresses.

- **Concur Detect**
  Concur Detect uses artificial intelligence (AI) and machine learning techniques to validate that receipt information, credit card statements, and bookings are compliant and within the policies of the organization. Concur Detect can also validate expense information against public and private databases to confirm if transactions are valid or fraudulent. Due to the nature of the solution, this means that organizations now audit 100% of their employee receipts.
- **Concur Drive**
  Concur Drive enables users to automatically record and track business mileage along with automatically turning these into expense items.
- **Budget**
  Budget from SAP Concur is designed to give budget owners an insight into the past and what is coming up in the future.
- **Receipt Audit**
  Receipt Audit provides a governance layer over Concur Expense to ensure that captured data is compliant with the policies and provisions of the organization. Receipt Audit both facilitates the identification of incorrect data entry and also can be used to detect fraud.
- **Expense Pay Global**
  Expense Pay Global provides some organizations in some countries the ability to trigger reimbursements without the need to integrate to a financial solution.

13.3 Travel

Together with the expense functionality just discussed, SAP Concur also offers a configurable online booking platform for business travel that connects would-be travelers to available flights, hotels, and a number of other transportation options. While this provides benefits for the traveler, it also helps to ensure that, from a business perspective, travel bookings are compliant from both a policy and procurement perspective.

The key objective of Concur Travel (see Figure 13.4) therefore is to provide a simple and accelerated booking process for the traveler while also providing assurance and compliance with corporate policy for the organization. Furthermore, because Concur Travel is provided on the same platform as Concur Expense, processing of subsequent travel receipts are embedded into one central solution.

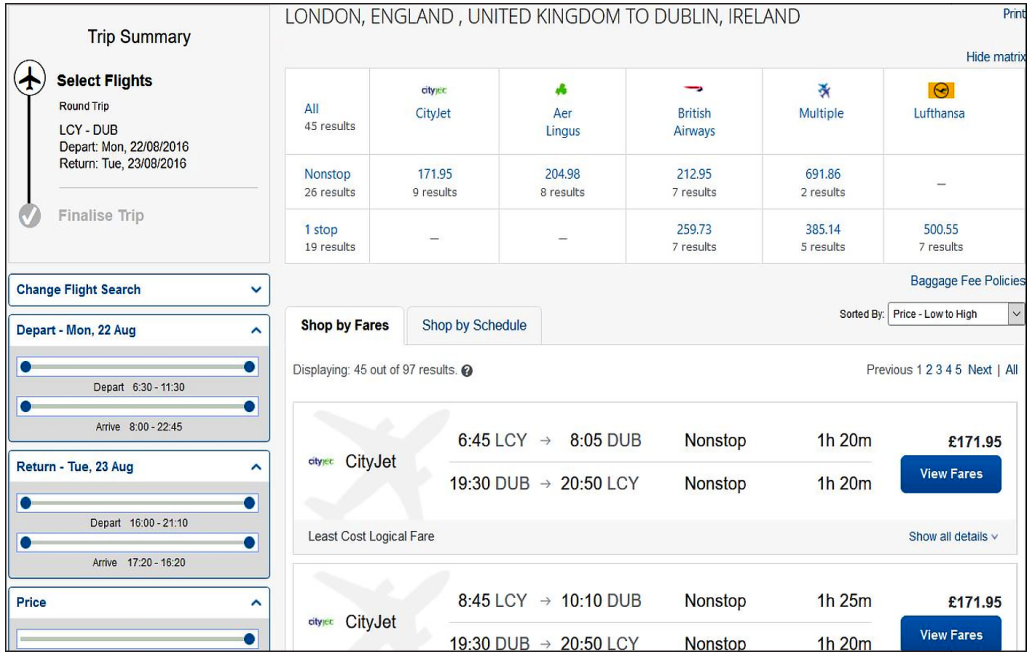

Figure 13.4 Example of Concur Travel

In the following sections, we'll dive deeper into the functionality and add-ons offered by Concur Travel.

13.3.1 Travel Management Companies

As previously mentioned, SAP Concur isn't simply software, rather it's a business network. Therefore, to use Concur Travel, the organization needs to have a contract in place with a travel management company (TMC) that specifically supports Concur Travel.

A TMC is an organization that manages corporate travel on behalf of businesses with the aim of saving both the organization itself and also its employees' time and money. A TMC typically offers the following services:

- **Offline and online travel booking**
  TMCs will either book travel on behalf of individuals or provide access to an online portal to facilitate self-service booking.

- **Duty of care assistance**
  Many TMCs offer duty of care assistance, meaning that they keep track of who is traveling where and when. In case of emergency, the TMC will also work to bring home travelers.
- **Negotiated rates**
  TMCs often negotiate directly with travel and accommodation suppliers to provide organizations with preferential rates together with specific benefits, such as extra baggage allowances, standard rental car upgrades, and reduced cancellation fees.
- **Travel information**
  Many TMCs will also provide travel assistance in the form of updates and contextual information for the traveler. This includes risk and security information for specific destinations.

What's Right for You?

Generally, organizations work with TMCs in one of two ways:

- **Indirect**
  In an indirect scenario, the TMC owns the relationship with SAP Concur. This means that efforts associated with implementation and ongoing innovation remain firmly with the TMC. For many organizations, this may be seen as beneficial because the entire travel booking process is outsourced. However, it also means that if the business wants to discontinue the relationship with the TMC at some point in the future, it will also lose the platform at the same time. TMCs often embed the cost of SAP Concur into the cost of its service, or they may charge a certain amount per booking for allowing the business to have access to an online booking platform.
- **Direct**
  In contrast to the indirect model, the direct model means that the organization itself (rather than the TMC) owns the relationship with SAP Concur. The organization is responsible for the setup and configuration of the system, but should the need arise, the business can switch the TMC to another without impacting the users of SAP Concur.

Whichever relationship with the TMC, the experience and process for the individual traveler remains the same. Prior to the first use of SAP Concur, the traveler must complete his own travel profile, which contains not only baseline information, such as

gender, name, company information, passport number, and emergency contact information, but also information pertaining to loyalty programs and frequent traveler information. Finally, a form of payment must be added if the business in question doesn't offer a corporate credit card program and where purchases aren't billed to one central credit card.

After the traveler profile is established, booking can begin. Travelers book trips via the travel wizard which is located on the start page of Concur Travel. Using the wizard, the employee enters basic travel information and SAP Concur returns all the results within the search parameters. At the same time, SAP Concur applies all company policies. Once selected, the travel options are forwarded to the TMC for booking.

13.3.2 Additional Functionality for Concur Travel

In common with Concur Expense, Concur Travel comes with the option of procuring additional capability:

- **TripIt**
  TripIt is a mobile application that allows users to plan and track their trips. A free version of the application is available and can be used in a standalone capacity; however, for organizations that use both TripIt and SAP Concur, the solution provides a live itinerary (including notifications of delay, etc.). TripIt is included in Concur TripLink, described next.
- **Concur TripLink**
  Concur TripLink is aimed at the estimated 40%–50% of employee travel that is booked outside of corporate travel systems. It allows for the capture of data from such places as hotels and taxis, and no matter where the travel expenses are incurred.

Many organizations mandate that prior to booking business travel, a traveler must satisfy certain prerequisite procedures, such as providing a justification for the trip and securing manager approval. Concur Request provides this functionality and integrates to both Concur Travel and Concur Expense, allowing information to flow between the three. Concur Request is available as a standalone service or integrated with Concur Expense and Concur Travel. This allows organizations the flexibility to either perform approvals outside of SAP Concur or as part of the SAP Concur process.

13.4 Reporting

Concur Expense, Concur Travel, and Concur Request come with basic reports included within the subscription fee. However, advanced analytics are available for an additional fee under the service heading of Intelligence.

Intelligence, as shown in Figure 13.5, contains a set of more than 200 standard reports that provide insight into T&E spend, company compliance, and a myriad of other information. It also contains a "bursting feature," which allows for reports to be tailored for individuals and automatically scheduled and distributed.

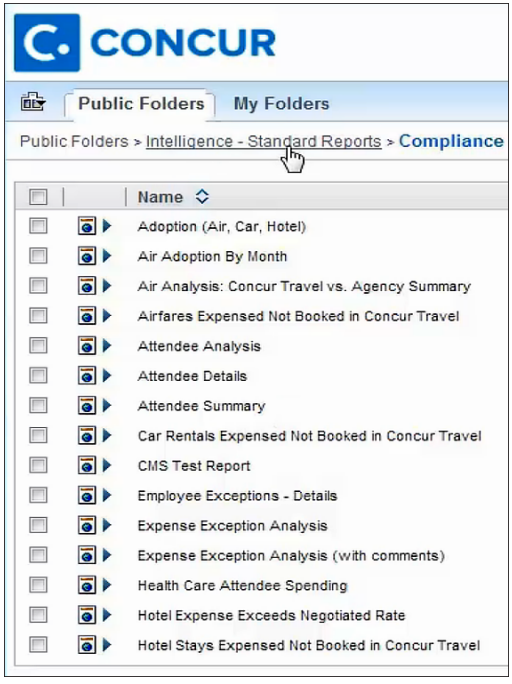
CONCUR
Public Folders
My Folders
Public Folders > Intelligence - Standard Reports > Compliance
Name
Adoption (Air, Car, Hotel)
Air Adoption By Month
Air Analysis: Concur Travel vs. Agency Summary
Airfares Expensed Not Booked in Concur Travel
Attendee Analysis
Attendee Details
Attendee Summary
Car Rentals Expensed Not Booked in Concur Travel
CMS Test Report
Employee Exceptions - Details
Expense Exception Analysis
Expense Exception Analysis (with comments)
Health Care Attendee Spending
Hotel Expense Exceeds Negotiated Rate
Hotel Stays Expensed Not Booked in Concur Travel

Figure 13.5 Example of Standard Reports in Intelligence

Reports that are available for invoice spend management include Aging Payables, Total Invoice Spend, PO vs. Non-PO Spend, and Top 10 Vendors. The dashboards are designed to be user friendly and intended to summarize relevant data into key performance indicators (KPIs) for key business stakeholders. The standard reports can be enhanced or custom dashboards created to allow an organization to effectively track its spending patterns and buying behavior.

13.5 Monitoring

Organizations have a duty of care to its employees who are traveling for business reasons. Knowing where employees are and knowing how to communicate with them in case of emergency necessitates coordination and control. A new service offered by SAP Concur called Concur Locate provides pretravel advisory and risk analysis and can enable organizations to locate employees in the event of natural disasters or emergencies.

The platform allows users to be contacted by text, email, or the installed mobile app. In the case of an emergency situation, employee status (e.g., safe, checked in) can be centrally monitored providing a real-time view. The solution also allows for 24-hour automatic notifications for risk and information.

As an extension to Concur Locate, SAP Concur also offers a service called Active Monitoring, which is provided by a risk management partner called Healix.

Healix controls Concur Locate on behalf of organizations, posts alerts to travelers, and locates and notifies affected employees. For alerts classified as high risk, Healix also requests a status update, which relevant employees respond to through the mobile app. In the worst-case scenario, Healix can also mobilize help to assist employees.

13.6 The Road Ahead

The success of SAP Concur will come if SAP can continue to make this the business network of choice for companies involved in the provision of services relating to T&E. By expanding the reach of the application through coverage in existing areas and expansion into others, it will effectively become the marketplace for all things related to business travel.

To support this aspiration, the road map for SAP Concur includes globalization, which will increase the scope of tax processing and country-specific requirements to allow SAP Concur to be a truly global solution. It has also committed to innovating in all areas of user interaction and onboarding in a move that is likely to see the expansion of the assistant functionality and the increasing role of AI and machine learning. Concur Travel also has a new interface planned for a future release.

However, together with external improvements, the road map also clearly signals an intention to improve the integration to other products in the SAP portfolio. Two such

proposals include the integration of Concur Expense to SAP SuccessFactors Employee Central and significant enhancements between Concur Expense and SAP Payroll solutions. These enhancements will see the further collapsing of siloed systems and link employee spend back to the employees themselves, meaning that all interactions and transactions performed by an individual can be collated and reported centrally.

In the next part of this book, we'll move on to the more technical side of SAP—data. We'll start by exploring SAP's major database and platform technologies, specifically, SAP HANA.

PART V

Data

Chapter 14
Database and Platform

This chapter introduces the wide range of considerations for running a complex SAP landscape in terms of database and platform, including what the options are and how certain decisions can influence the effectiveness and capabilities at your disposal.

Having looked at many business capabilities and functional areas of an SAP landscape so far, we're now going to switch gears and consider where and how these capabilities are deployed and run. For those familiar with SAP systems and solutions, this is an area that has experienced some of the most dramatic changes in recent years. It also continues to offer the most opportunities for further change.

Many books could be (and have been) written that go into granular detail around these topics, so here we give a high-level overview of how modern SAP solutions depend on their core building blocks—databases and platforms—and lay out what a "new" SAP landscape could look like.

This chapter will look at these familiar components and show how the boundary between database and platform is blurring, as well as how SAP's latest technology innovations are striving to enable better, more efficient innovation while still maintaining solid, reliable, and robust business capabilities.

After reviewing how this relates to our business case for Bault Robotical, first we'll take a quick look at how we define and understand database and platform within the context of current SAP and related IT solutions. The remainder of the chapter will unpack the major components of database and platform—database technology, application platforms, and user interface (UI)—and the key SAP solutions that support each.

14.1 Business Case

Bault Robotical already has many different database technologies deployed across its business, ranging from Microsoft Excel right up to enterprise-grade Oracle, and everything in between. The company's SAP landscape runs on top of Oracle databases. Some of its custom applications were built prior to the installation of SAP, and hence some parts of the business still use Lotus Notes. Many departments make use of both custom and proprietary solutions for their own specific needs, each requiring its own database platform and instance. Without even considering the overhead in terms of skills and knowledge, simply managing the compliance and commercial arrangements around such a mixture of technology causes many issues.

The siloed approach to data to support so many disjointed systems has created a cottage industry of system development and management, as well as propagating shadow IT, outside of the sight or control of the IT department, with large swathes of data regularly being copied, manipulated, and moved between systems. This generates massive redundancy with no one single source of truth and no easy way to manage data artifacts in a holistic manner. Ultimately, there is a large proportion of incomplete and inaccurate data across Bault Robotical's numerous systems.

While this poses a not insignificant problem when it comes to generating reports and insight (which we'll cover in more detail in subsequent chapters), it also has a more fundamental and equally challenging impact throughout the business processes embedded across Bault Robotical. Further, many of the perceived weaknesses with the current landscape and its capabilities are as a direct result of disparate, incomplete, and inaccurate data across this multitude of data repositories—Bault Robotical's users simply have no confidence in what the system is telling them.

Back when SAP was first implemented for Bault Robotical, the decision around which database flavor would be deployed into the overall SAP stack was likely driven by a combination of technical preference by the people installing it and straightforward commercial negotiations. Likely there was no real consideration as to what the database could do; quite simply, if it was certified for SAP, it was an option.

In addition, because the SAP landscape was up and running, there has generally been very little consideration of or interaction with the database, other than by the SAP Basis/tech/infrastructure teams who essentially keep it running. (These teams are provided by an external vendor who Bault Robotical uses for maintenance and support.)

Per the current state of data, Bault Robotical's application development approach has taken on something of a Wild West flavor. As well as numerous platforms sitting on top of the various database instances, a wide selection of pure application development platforms are also being used.

Some of these are owned and deployed by the IT department, but many are owned and used by various business teams. More often, these are low-complexity solutions to meet specific reporting needs or to enable capture of data as part of a process not apparently available in Bault Robotical's core SAP landscape. This leads to further complications around integration and data integrity.

Both the business and IT teams agree that many solutions in place have been deployed as band aids as a short-term fix to a pointed scenario; however, they have become an essential part of keeping the business moving, and now they can't be removed.

This situation is made worse by a lack of true integration between the various systems and the wider SAP landscape; as mentioned previously, lots of man hours are spent manually moving data around and manipulating it for use. This leads to failings in the many custom applications around the business, and ironically a lot of blame is targeted at the core SAP landscape as being closed and not easy to work with.

Even if Bault Robotical could magically resolve the numerous data and siloed process issues we've already discussed, there would still be significant negativity to the general user experience (UX), and more specifically, the UI component of the current SAP landscape.

The SAP graphical user interface (SAP GUI) and the associated complex approach to navigating and working with SAP systems has become a significant challenge for all Bault Robotical's users. As the world of IT has changed, and, more specifically, as consumer solutions have evolved and become increasingly elegant and refined, the SAP GUI has looked increasingly past its sell-by date.

14.2 Architecture Overview

It's easy for most people to produce at least one example of where a database would be relevant in their line of work: customers, sales orders, stock, patients, employees, payments, members, and so on. While the term "database" has become synonymous with any collection of information, in the context of this book, and indeed more importantly in the context of a large and complex SAP system, it's important to define and understand more technically what a database is.

For those with an understanding of the more traditional SAP landscape, the database is quite simply the component of the SAP systems where all data for the system is stored. It could be said that an SAP ERP system is simply a very large and complex relational database, although this is still only scratching the surface.

A typical and well-recognized architecture pattern for SAP systems, and indeed many other software solutions, looks something like Figure 14.1, with multiple database nodes, multiple application nodes, and generally a single client node.

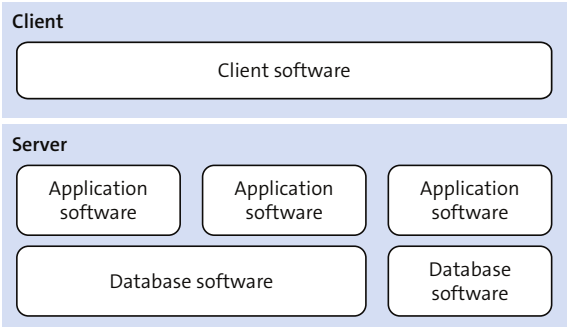

Figure 14.1 Generic, Three-Tier SAP Landscape Showing Client-Server Architecture

This is a somewhat simplified view of course, but it serves to highlight where and how a database fits into the architecture for an SAP system.

It's also important to understand that the term "platform," at least within the context of established SAP systems, typically comprises the combination of the application and database components, that is, what we see in the preceding figure as the server side. We'll quickly walk through these three core components and how they interact:

- **Client software**

  This is the entry point into the software. In the established world of SAP, for most users, this typically equates to the SAP GUI, which has been a key component of the SAP landscape for many, many years.

  For many existing users of SAP systems, one of the most often cited areas for improvement is the general user experience (UX) as a direct result of this old UI design. Ignoring the limitations for now, the key thing is to understand that SAP applications must have a way for the users to interact with the logic, capabilities, and functions of the application.

Figure 14.2 shows a typical transaction running in the SAP GUI to create sales orders. This is the sort of screen call center operatives handling inbound customer orders will likely stare at for a lot of their day.

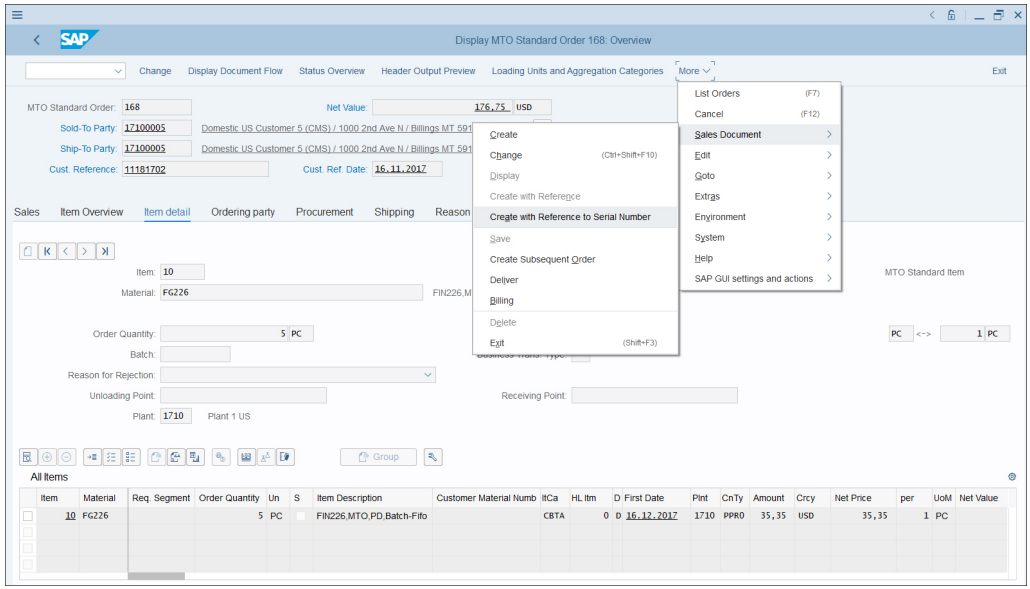

Figure 14.2 Example of Sales Order Creation in SAP GUI

In the traditional client-server architecture SAP has used to date, the SAP GUI software must be installed on every device used to access the solution; therefore, if you have 1,000 people in your business who need access to SAP, that's 1,000 installs of the SAP GUI software to install and maintain. Further, the SAP GUI generally only works well on PC-style machines (Windows or Mac) and doesn't play nicely (read "at all") with mobile devices, such as phones or tablets.

- **Application software**
  In the traditional client-server architecture, the application software is installed and runs on server-level hardware and software, often in a company's data center or within their hosting partner's data center.

  Users interact with the application software via their client software over a live network connection, with all processing, calculations, and general "work" being performed on the server side and then presented on the client side.

The general approach within the world of SAP, and indeed many other enterprise software solutions, is to have separate system instances to support the three main lifecycle stages of software: development, quality, and production (Dev, QA, and Prod for short), which is why three application nodes are shown in Figure 14.1. This is often referred to as a three-tier landscape. This equates to three physical servers that need installing, configuring, and maintaining.

- **Database software**

  The final layer of the architecture is where all data is stored (or persisted) to support the applications. For many application stacks, the database is typically *only* used to store data and provide access to it via the application layer.

  As with the application layer, it's common practice to provide separate Dev, QA, and Prod nodes at the database level to provide segregation of data and add governance and control over changes. It's also possible to share a database node across multiple application nodes.

  Within the world of SAP, the database layer is almost always abstracted behind the application layer, with no real direct interaction between the client layer (the users) and the data within—everything goes through some sort of processing or manipulation.

  This has many positive outcomes but also, as you'll see as this chapter develops, isn't necessarily the best way of architecting systems in the modern world of technology. As a result, SAP has fundamentally changed its approach to application architectures, especially at the database layer and propagating upward through the rest of the stack. We'll dive much deeper into this topic in the following sections.

14.3 Database Technology

A widely accepted description of a database is an electronic store of information, in a structured or organized format, which can be accessed by numerous channels. In simple terms, it's where information is both stored and accessed. In effect, it becomes the memory of an application, allowing information to persist and be used over time.

These two very distinct and basic aspects of a database, storage and access, have also been probably the most static elements of database technology for many years. Typically, these capabilities are accessed through a database management system (DBMS), which contains the software and services that enable the basic access and storage functions on the database platform.

With this in mind, it's worth reviewing how SAP entered the database market. Late in 2010, SAP made the leap from just developing and supplying application software to launching its own database technology called SAP HANA. Standing for High Performance Analytical Appliance, this was a significant departure for a company that had traditionally focused more on the provision of best practice, best-of-breed business solutions.

SAP wanted to remove the limitations of enterprise resource planning (ERP) and management information systems (MIS) solutions to date, so the company started from scratch and designed SAP HANA. As a data, analytics, application, and integration platform, it offers capabilities that enable development, operation, and management of full applications, from data persistence and integration, right up to frontend processing. At its core, SAP HANA is a fully in-memory, columnar-store database engine that enables the combination of online transactional processing (OLTP) and online analytical processing (OLAP), offering a step-change in terms of performance at the database level. It enables you to combine transactional, analytical, and predictive data sources and insights with real-time reporting and decision-making capabilities to deliver solutions that simply weren't possible before—the gap between question and answer is rapidly closed.

Out with the Old

Back in the 1970s when SAP was first formed, the founders had the ambition to fundamentally change how businesses deployed and used computer systems, essentially defining the ERP sector in the process. Key to this was the need for better, more consolidated access to information and data across an organization's entire operations. The move to integrated ERP solutions delivered this in spades.

However, a continuing limitation, even in a tightly integrated solution, was access to timely data. Quite simply, the hardware platforms available combined with the database technology didn't enable real-time querying of data. The "batch job" was adopted, and people accepted that answers to their questions could take some time to acquire.

Fast forward to 2010, and the general price of server-level hardware had reduced significantly, in conjunction with the performance and throughput of processors and memories constantly improving. Why is this important? Suddenly, it was possible to build a server with enough processing power and RAM to hold an entire ERP system in memory, at a price that didn't require space program investment levels.

Let's run through the capabilities offered by SAP HANA that broadly sit under the umbrella of database functionality. While doing this, we'll endeavor to explain why they are important and, crucially, how they can offer advantages to businesses over and above just accessing data more quickly.

The capabilities are broken down into three broad areas: database services, data access, and analytics processing. (SAP HANA also has numerous application platform and administration capabilities, which we'll explore in Chapter 18 and Chapter 19, respectively.)

14.3.1 Database Services

The following capabilities of SAP HANA are SAP's approach to reinvigorating many of those traditionally associated with the storage functions and closely related to the DBMS services, offering better methods to work with large volumes of data in a more efficient and effective manner:

- **Columnar store, with transactional and analytical processing**
  Key to some of the performance gains via SAP HANA is the column store approach to data persistence. This allows queries and reads of data in the database to be processed with much greater throughput than traditional row store systems (row storage is the long-established, de facto method of storage in databases).

  The performance advantage of this columnar approach is further expanded by SAP HANA's ability to process both transactional and analytical queries on one data set. This allows users to both review high-level key performance indicators (KPIs), trends, and other such analytical artifacts while still being able to drill down and navigate between the underlying transactional posts.

  This approach also removes the need for traditional database artifacts, such as indexes and materialized views, again reducing the complexity of the data model and limiting the burden on database administrators. Customers don't necessarily need to replicate or synchronize data out to other analytical platforms either, saving on the cost of software and hardware, as well as reducing complexity and redundancy in a landscape, which, in turn, reduces the complexity and overhead of supporting such a landscape.
- **Multicore utilization and parallelization across hardware**
  Taking full advantage of the power of modern hardware, SAP HANA runs its queries in a parallel nature, partitioning and distributing the processing load across

multiple logical servers. With processors and RAM able to run anywhere from 30 to 100+ times higher throughput than when the data is stored on hard drives, the advantages are significant.

This is one of its key, core features. The manifestation of affordable and performant hardware has been used to enable much of the processing that is provided elsewhere by SAP HANA. It also enables scaling out of the server, so as your data volume and processing needs grow, so can your SAP HANA size.

However, scaling can come at a cost. As an example, a 64 GB instance of SAP HANA could be considered cheap in the enterprise world, with a 4 TB instance probably being classed as affordable for most organizations. Scale that to 64 or 128 TB, and it can only be considered expensive. Beyond that, affordability becomes a significant concern.

- **Compression**
  At the core of SAP HANA's data persistence (and an important balancing factor to the preceding hardware costs) is how it compresses data when storing it. This can significantly offset the costs associated with an SAP HANA instance.

  This can balance out the costs mentioned previously because with SAP HANA's compression, you typically won't need a database as large as you currently run. Compression ratios of 1:5 right up to 1:50 are often cited as achievable. There is no hard and fast ratio for all, as depending on the type, size, usage, and so on of the table concerned, the ultimate compression ratio can vary; 1:10 is often used as a good average benchmark.

- **Multitenancy**
  Another capability that can drastically reduce the complexity of the IT landscape is SAP HANA's ability to support multiple tenant databases on one SAP HANA instance, for example, running two database tenants to support your DEV and QA instances of SAP ERP on one single SAP HANA server.

  This allows for a much simpler approach to hardware provision and ongoing maintenance and support, in turn, offering cost efficiencies.

- **Multitier storage**
  As well as offering compression to offset the increasing cost of hardware, SAP HANA also has data tiering capabilities. In simple terms, this allows data to be stored in buckets of decreasing performance capabilities, dependent on how important or how often the data is accessed. A typical strategy for tiering data

could be based on date; for example, all customer sales orders within the past 12 months are in the top tier (often referred to as hot data), and orders over that threshold are kept in the lower tier (warm data; we'll touch on cool data shortly, when we talk about Apache Hadoop and related capabilities).

This has two implications: First, only the most important data is held in the expensive "in-memory" aspect of SAP HANA, whereas the less important data is held on disc storage, which again can reduce the amount of expensive hardware needed for a certain size of data. Second, this can impact the performance associated with the lower tier data.

- **Data modeling**
  As mentioned, the line between database and application platform is blurring. Data modeling is the first capability we come across that demonstrates that.

  The data modeling capabilities within SAP HANA allow application developers to layer business logic and capabilities over the raw tables and data held in SAP HANA, essentially building up application logic.

  Remember the classic three-tier architecture we described in Section 14.2? We clearly saw that the application layer was separate from the database layer. That instantly presents an overhead for any application running in the application layer, as it must communicate with the database layer, sending commands and receiving responses. Anything that requires an interaction between the database and application layers will create a performance overhead.

  SAP wanted to remove this overhead and did so by enabling lots of the application logic to be developed and more importantly run in the actual database engine. This puts the logic right next to the data, removing potential overheads and in turn increasing performance. Compound this with the core components shown previously, and you get an application processing engine that can use SAP HANA's processing power.

It's fair to say that many of the capabilities, such as columnar storage, in-memory processing, parallelization, and so on, aren't completely new concepts in the world of database platforms. Many of them have been around for a significant time. Where SAP has been clever is by combining these and other capabilities to achieve a sum greater than the parts: a system that can take advantage of the latest, high-performance processors and memory, while managing and offsetting the cost of those components by redefining how the size of your database is considered.

Out with the Old

SAP has coined the term "code pushdown" for this act of deploying application logic in the database engine itself, rather than in a separate application server.

In simple terms, the old approach of pulling data out of the database and processing it in the application layer has been reversed, and with SAP HANA, the application logic should be "pushed down" into the database where SAP HANA has the processing engines necessary to run and process it.

This is one of the most significant changes facing existing SAP developers, who will be used to working with a more traditional three-tier architecture. With the capabilities available via SAP HANA data modeling tools, SAP developers must learn more database native development practices that haven't been necessary in the world of SAP, especially ABAP, for many years, if they want to take full advantage of SAP HANA's power.

14.3.2 Data Access

We've looked at how SAP HANA offers new and different capabilities at the very core of the database platform for both storing and managing the database itself. Of course, unless you're simply keen to store data and never do anything further with it, you'll no doubt want to access your data again to review, change, or use it as part of processes or calculations. SAP delivers flexibility with regard to data access by offering services that greatly expand what would normally be expected in this area, even going as far as enabling you to work with data both stored within SAP HANA and elsewhere.

Let's explore the various data access options offered in SAP HANA, as follows:

- **Virtualization (and federation)**
  Putting *all* your data into an SAP HANA instance probably isn't a sensible design, as you would need a large and expensive database. If you need access to outside data as an application or database developer, you would typically have two options: (1) replicate the external data into your database, or (2) call an application programming interface (API) or interface of some sort each time you want to use the data. Both options have pros and cons, which are outside the scope of this book.

  SAP HANA's federation and virtualization capabilities offer the developer a third option: use a component of SAP HANA called Smart Data Access (SDA), which

allows you to set up a remote data source as if it was part of your SAP HANA database. In SAP HANA, a virtual table is created that offers the data from the remote source for further consumption, processing, and development as if it was stored in the SAP HANA instance itself—except, it isn't.

This reduces the potential need to store large volumes of data in SAP HANA while also ensuring that you can access correct, accurate data from a reliable source, without having to define and manage replication or integration solutions.

- **Replication and extract, transform, load (ETL)**
  Of course, there are scenarios where it does make sense to replicate data into your database. Maybe the data expires and disappears after a certain time frame, or maybe the supplier only makes a subset available, and you need more.

  Regardless of the reason, SAP HANA includes an array of capabilities for loading data into its tables, most notably the Smart Data Integration (SDI) tooling.

  This offers batch and real-time replication capabilities, allowing for updates of data at the right time dependent on usage and the capabilities of the provider. Transformations of the data can be built as part of the replication to ensure you get data in the format you need.

  SDI and SDA can work in partnership and complement each other. Defining your data acquisition strategy is just as important as implementing it in the tooling provided.

- **Quality**
  With the various method of pushing data into SAP HANA, it's of course important to consider the quality of that data. As well as the transformation capabilities already mentioned, SAP HANA also has a range of services for cleansing or enriching information as it's loaded.

  Geospatial information can be enriched, for example, allowing it to be used as part of your data modeling and application development activities. For example, you might have a piece of data representing a Bault Robotical robot and enrich that with geospatial data so you can represent it on a map. Now combine that with real-time weather for your asset's location by using SDA, and your application could be clever enough to only send an engineer when the sun is shining!

- **Remote synchronization**
  We've covered a few methods for moving data into SAP HANA, mostly with a replication pattern at their core (i.e., data is copied from source to target, and both systems have a full set of the data). The remote synchronization service is an additional option that delivers a synchronization pattern (i.e., data is copied from

source to target and from target to source to align the two databases with any changes).

Synchronization is often used when the connection between source and target is limited or can be intermittent, for example, between an application running on a mobile device with partial signal coverage and a back-office database.

- **Apache Hadoop integration**
  Earlier, we touched on different tiers of data and mentioned cold data; we've also looked at several ways of integrating remote or external data into the SAP HANA processing engine. Bringing these topics together leads us to consider the concept of big data, that is, massive volumes of information that are often of the cold variety.

  Due to the volumes, more cost-effective ways of storing this data have been developed, and a leader in this space is the Apache Hadoop platform. This enables the storage, interaction, and manipulation of massive volumes of data across a distributed storage architecture. Of course, it makes sense to want to process these massive data stores alongside your "normal" enterprise data, so SAP has built tooling into SAP HANA that enables this integration and use of data.

14.3.3 Analytics Processing

The final part of the database puzzle is bringing all this data together and performing various augmentations or calculations on it to drive insight and produce analytical outputs based on the data. Now we'll take a deeper look at this area of SAP HANA by exploring some of the key features it delivers for analytics processing:

- **Spatial engine**
  SAP HANA has extensive capabilities to work with spatially aware data, enabling the inclusion of geographic and location context layers to your data and applications.

  As well as being able to present spatial information, calculations and application logic can also be developed to include spatial data. This could be used to visualize historic locations of robots, for example, or calculate those robots inside a physical area.

- **Graph engine**
  Many sources of data have what is known as a graph relationship, that is, data that is highly connected to other data. The most obvious example is a profile on Facebook, where an individual is connected to many other individuals. The connections

between these many profiles could be processed by a graph engine (in fact, one of Facebook's main engines within its platform is called its graph engine).

The graph engine within SAP HANA, like the other engines, allows for not only working with graph data but also combining it with other types of data and adding it into application logic to build complex solutions. For example, Bault Robotical could use the graph engine as part of its sales and marketing efforts to determine what customers often buy at the same time and then make recommendations to other customers with a "customers who bought product a, also bought product b" message.

- **Predictive functions and machine learning**
  SAP HANA has a number of built-in functions that can consume data and provide you with predicted answers to queries, answer what-if analysis questions, and generate forecasts based on trends of transactional data. It also allows you to consume and develop your own predictive models.

  Further, with the addition of machine learning capabilities, many of these predictive models can be set to continuously learn and improve over time while automating existing manual decisions and/or steps in a business process.

- **Search functions**
  Much of what we've discussed so far has been focused on structured data, that is, data which follows a prescribed format and happily resides in database tables and follows rules and constraints.

  SAP HANA can also manage unstructured data, such as images, Microsoft Word or Adobe Acrobat documents, text files, and web content (e.g., HTML files). To avoid SAP HANA becoming another file storage system, it also has built-in search capabilities so that you can query the contents of these files and search for key words or values. A fuzzy search capability allows for a certain margin of error, which can be controlled as part of the search.

- **Business functions**
  As well as the many functions and logic that an application developer can build from scratch within SAP HANA, it also comes with a range of built-in, reusable functions for common tasks. These are primarily of use in the financial area of business and offer efficiency advantages to save developers building common routines and reinventing the wheel.

- **Text analytics**
  Along with the search capabilities mentioned earlier, SAP HANA can perform

analytics on unstructured data too, allowing you to work with documents stored in SAP HANA and consume them as part of your application logic.

As well as natural language processing capabilities (consider the engines that allow you to talk to your Amazon Alexa or Apple Siri), this part of SAP HANA also enables capabilities such as sentiment analysis and text-mining to pull valuable data out of documents.

For example, Bault Robotical can use SDA/SDI to capture posts on Twitter and Facebook that refer to its new product launch and determine if the feedback is good or bad.

- **Streaming analytics**
  Most of the data we've discussed so far in this list has been static, even where it's in real time. The streaming engine in SAP HANA works with real-time data as it hits the SAP HANA system in real time—real-time squared if you will.

  A good example of using this could be taking a historic data set and using it to compare against real-time information being streamed from a group of Bault Robotical's robots deployed in a production site. If data relating to one of the robots goes outside of a given boundary, the streaming engine can trigger an event, which can be used as part of another application and respond accordingly.

- **Series engine**
  Not dissimilar to streaming data, series data typically arrives in a stream but comes enriched with time information. More often than not this sort of data is generated by Internet of Things (IoT) devices and sensors.

  The series engine in SAP HANA can use this sort of information to make calculations and again drive application processing to interpret and perform a suitable follow-up action. Bault Robotical may use this to monitor the fluctuations of currency exchange (pulling data from external forex systems via SDA/SDI) and purchase raw materials on the global market when getting a price within a set boundary.

14.4 Application Platforms

Here we'll explore the many new capabilities offered by the SAP Cloud Platform, looking at how it fits into the broad SAP landscape and especially how it offers different ways to build solutions. (What we *won't* get into in detail again is SAP HANA, as

although that is also an application platform, we've already covered it in the preceding pages.)

Out with the Old

There is some history to SAP's new application platform: Internally to SAP, it first had the codename "Neo," inspired by the character from the film *The Matrix*. When it first became fully available, it was called SAP HANA Cloud Platform. While this was some great marketing from SAP in terms of supporting the general push for SAP HANA-related solutions, it worked against the platform's success, as people believed it was only relevant for SAP HANA database-related solutions.

Thankfully, SAP streamlined the naming and the product became known as SAP Cloud Platform. This reinforces the fact that while you can have SAP HANA as part of your SAP Cloud Platform account, you don't have to.

With SAP Cloud Platform, SAP has firmly laid the foundations of three key criteria for future application development:

- The adoption of open industry standards and tooling for many facets of application development
- The move to cloud-native as the standard approach for application design, development, management, and support
- The enablement of many DevOps-inspired capabilities, bringing together activities that were previously segregated between different teams

These three criteria come together with a common, fundamental goal: to enable faster, more flexible application delivery. This is still all within the general ambition of extending, customizing, and generally improving the standard capabilities delivered within SAP's standard business applications.

There are two main flavors of SAP Cloud Platform:

- **Neo**
  Building on the points earlier around SAP Cloud Platform's naming history, Neo has become a core part of its offering; it now refers to the capabilities available on SAP Cloud Platform in SAP's own data centers. Generally, Neo is often the environment many organizations turn to when they are extending or customizing SAP business applications, such as SAP SuccessFactors, SAP S/4HANA, and so on.
- **Cloud Foundry**
  The Cloud Foundry flavor of SAP Cloud Platform can in principle be deployed into

any data center that adheres to Cloud Foundry standards. This gives you great choice in terms of where/how your solutions are hosted, as you can make use of existing relationships and usage of other infrastructure-as-a-service (IaaS) providers such as Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, and so on (all of whom have agreed to partnerships with SAP at time of writing (fall 2018) and support various SAP Cloud Platform capabilities).

At time of writing, SAP is still working to deliver feature parity between Neo and Cloud Foundry flavors of SAP Cloud Platform. A reasonable prediction would be that, over time, Neo will be retired, and a single common approach will be the go-to standard.

These different flavors of SAP Cloud Platform can be seen by looking at the regions available from the main SAP Cloud Platform cockpit, as shown in Figure 14.3. This also shows the breakdown (as of fall 2018, so highly likely to have changed by the time you read this) between the various IaaS providers mentioned earlier.

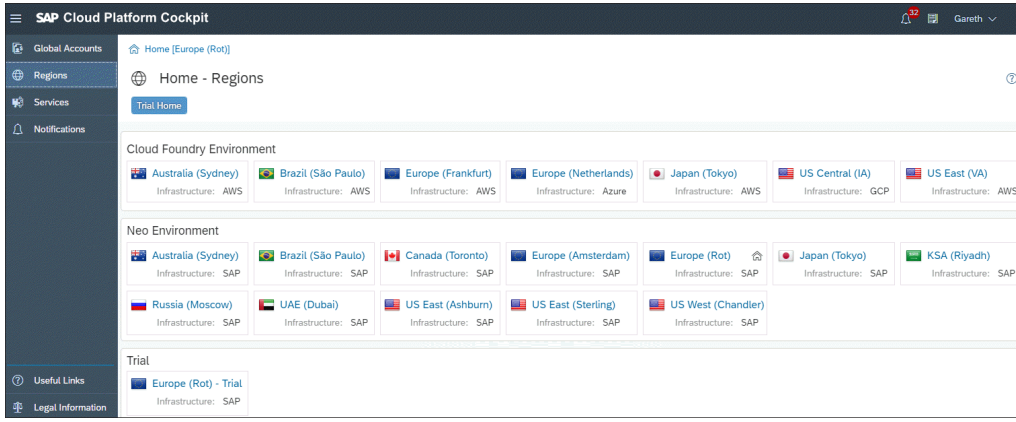

Figure 14.3 Regions Available for Cloud Foundry and Neo

As a final point on hosting, SAP doesn't want to be/become a pure IaaS company. Building data centers and hosting hardware and software isn't the company's secret sauce, and organizations such as AWS and Microsoft are far more mature and therefore effective in this space. With the move to open standards as part of SAP Cloud Platform, the multicloud approach SAP has commenced via AWS, Azure, and others will no doubt continue to mature. The end of this journey likely will be a version of SAP Cloud Platform that can be deployed into any data center, as long as it subscribes

to the requisite open standards. This means we're likely to see a version of SAP Cloud Platform that can be deployed into private data centers.

Crucially, SAP Cloud Platform can be used to deliver solutions that work with versions of SAP even as old as R/3 4.7. Even more crucially, it can be used to deliver solutions where there are no other SAP solutions in place.

Let's take a helicopter view of the capabilities of SAP Cloud Platform and how they could be of interest to Bault Robotical as the company evolves its landscape. For this, we'll loosely group them as core capabilities, that is, services that are established and part of the main offering, and SAP Leonardo services that encompass the more innovative elements of technology.

14.4.1 SAP Cloud Platform Core Capabilities

SAP Cloud Platform offers the following key capabilities:

- **Analytics**
  As well as supporting another pure cloud product from SAP, SAP Analytics Cloud, which we'll discuss in Chapter 16, SAP Cloud Platform has several capabilities to manage and enable insight-driven features as you build. Think of this as a way to include analytical capabilities into your custom solutions and extensions without having to code them from the ground up.
- **Business services**
  SAP has taken the SaaS model to a lower level of granularity and created several specific, scope-constrained services that run via the SAP Cloud Platform landscape. These services, such as the tax service, enable organizations to consume common, repeatable business logic from SAP without having to build and deploy it themselves. This approach aligns with SAP's move to a more micro-service architecture (sometimes referred to as service-oriented architecture [SOA]—done properly!).
- **Collaboration**
  One of the most common use cases for modern, digital solutions is to enable collaboration in various forms. This might mean a simple application to allow sharing of information between departments or allowing links in a supply chain to collaborate across organizational boundaries. Many of the services on SAP Cloud Platform can and do enable collaboration in different ways, such as mobile services to allow field workers to interact with office-based colleagues, or SAP's enterprise product, SAP Jam, which supports a collaborative portal approach to

extending solutions. The range of specific collaboration services, as well as the wider capabilities that also support this ambition, provides functionality to suit differing needs across business-to-business (B2B), business-to-consumer (B2C), business-to-employee (B2E), and other business scenarios.

- **Data management**
  Take a moment to consider the introduction to this chapter, where we looked at the database component in current SAP landscapes. In short, the database level simply stored data. Modern digital opportunities and challenges require much more flexibility and scope, and this is an area that has been core to the SAP Cloud Platform since day one. Now, with a range of both SAP and non-SAP database engines, big data services, and connectivity to other data-related technologies, the flexibility is inherently part of the platform. These services allow customers to action all tasks relating to data, from administration through to modeling and on to storage. They also offer options comprising both SAP proprietary offerings, such as SAP HANA and SAP Adaptive Server Enterprise (SAP ASE), as well as other industry-standard offerings such as PostgreSQL and Redis.
- **Developer experience**
  There has been a saying around the world of general IT for some years that "developers are the new kingmakers" stemming from a book of the same name. In line with this perspective, much of SAP's development of SAP Cloud Platform has been with developers in mind. The tangible outcome of this is a suite of integrated development environments (IDEs) and tooling that ease development tasks, ultimately with the aim of enabling and empowering developers to get the job done efficiently and effectively. This also means that existing, experienced SAP developers face a not insignificant change in their working methods to really capitalize on SAP Cloud Platform's capabilities. One of the most notable changes is because of the inherent cloud nature; that is, most tools are available directly in the browser, meaning the only prerequisites to be productive are Internet connectivity and browser software.
- **DevOps**
  As the need to be more agile continues swiftly, the silos and formal borders between roles and teams that have long been a staple in the IT industry must be broken down. Often, this manifests as the bringing together of development capability with operational capability (in traditional SAP parlance, ABAPers and SAP Basis). The varied services on SAP Cloud Platform drive an absolute necessity for developers to be more aware and capable at administrating and managing

resources, where previously they would typically have looked to other technical teams. Conversely, it also opens up development opportunities to those technical teams who previously depended on developers for support.

- **Integration**
  With so much data, so much collaboration, and so many systems peppered throughout typical modern landscapes, there is always a significant need to integrate in many different ways. We'll dive into this topic in much more detail in Chapter 18, but for now, it's important to understand that SAP has delivered a complete toolset on SAP Cloud Platform to support various integration patterns, from API-led micro-services through to more heavyweight middleware approaches. Especially pertinent is SAP's approach to enabling off-the-shelf integration solutions between SAP's core SAP ERP and SaaS software solutions.
- **Master data**
  As SAP continue its push to place SAP Cloud Platform firmly at the center of its customer landscapes, and as the wider IT industry continues to promote the importance of quality data, the need to apply consistent and repeatable cleansing, manipulation, and transformation of data grows. SAP Cloud Platform has core capabilities, similar to the SAP HANA platform, which enable these features and again lend themselves to be used as part of larger, more complex solutions.
- **Mobile services**
  SAP Cloud Platform includes a full range of capabilities in this space from application development through to management (SAP Cloud Platform Mobile Services). Most notably, SAP has released software development kits (SDKs) for both iOS and Android mobile platforms to enable organizations to deliver complex, native mobile applications that follow the SAP Fiori design language (or not, as the case may be); you can design and deliver applications with full flexibility in terms of UI style. SAP also has provided lightweight hybrid-style tools and wizard-based development functions to support faster, rapid application delivery. More broadly, older solutions found on SAP Mobile Platform have been and continue to be migrated to or replaced by services based on the SAP Cloud Platform. Those familiar with Syclo Agentry, which is used heavily in the field of engineering and asset management world, will be pleased to know there is an Agentry on Cloud option, for example.
- **Orchestration**
  Given there are so many varied services providing a wide range of capabilities, augmented with SAP's broad business suite landscape (comprising on-premise

and cloud business applications), a real challenge is how to tie together a process that crosses over technical, organizational, and geographical boundaries. This is where the orchestration capabilities of SAP Cloud Platform come into play, allowing you to orchestrate and build processes that consume and utilize various components. This central workflow-like capability is a natural successor and replacement for SAP's previous forays into the world of business process management (BPM).

- **Runtime and containers**
  Core to SAP Cloud Platform are the runtimes that often form the main building blocks for solutions. With Cloud Foundry, you can pretty much "bring your own" language to the SAP Cloud Platform and combine various languages to achieve desired results, as well as relying on the SAP-provided Java, SAP HANA, and web runtimes.
- **Security**
  With a landscape partly existing in the cloud, security is likely more of a consideration than when organizations held all of their systems in their own data centers. The core services provided by SAP Cloud Platform allow for the typical range of user and identity management, again which can all be reused as part of bigger, more complex solutions. Key features range from single sign-on (SSO) to integration with corporate identity stores. Security is also embedded at the micro level down through SAP's runtimes and within the platform itself to ensure organizations can control access right through the lifecycle of a solution, from design to support.
- **User experience (UX)**
  While we'll talk in more depth about UX and specifically SAP's approach to UI shortly, it's worth mentioning the range of services on SAP Cloud Platform that can take you from user research, through prototyping, and on to solution development and refinement. As you'll see later in this chapter, SAP has focused heavily on refreshing this area of its software, and it would be a fair argument to suggest the services on SAP Cloud Platform have been part of the early charge. SAP Build, which supports the design and research phase, is complemented by development tools and guidelines, all of which support designers and developers in delivering solutions that have a focus on quality UX much more than with previous SAP software. Taking their renewed focus on UX a step further, SAP has even delivered content to help customers design solutions and architectures using a consistent and repeatable style (for more information, check out the content at *https://wiki.scn.sap.com/wiki/pages/viewpage.action?pageId=477829554*).

14.4.2 SAP Leonardo

A few of the SAP Cloud Platform capabilities are collected here under the SAP Leonardo banner because this is a distinct offering from SAP that warrants being separated from the rest of the SAP Cloud Platform capabilities. While SAP Leonardo is a package of existing products, services, and methodologies with more flexible commercial factors, it's built on a number of SAP Cloud Platform services.

> **Digital Disrupter**
>
> This entire section is devoted to digital disrupters. SAP Leonardo is constantly changing, and it's likely that by the time you're reading this, new features and technologies will already be popping up. SAP Leonardo is deliberately modeled to support any and all new technology as it appears. The three areas we'll cover in this section (blockchain, IoT, and machine learning) have only just begun to "disrupt" the area of database and platform.

The following are the key SAP Leonardo capabilities built on the SAP Cloud Platform:

- **Blockchain**
  Blockchain is a comparatively new technology that in recent years has promised to be the answer to absolutely everything. In simple terms, it's a digital, distributed ledger taking the ownership of transactions from one single system of record to be distributed and agreed on by multiple parties. Its main use (to date) has been as the foundation for the plethora of "crypto-currencies" that have sprung up. Through early 2018, SAP has been working on a blockchain service for SAP Cloud Platform, which became available during the writing of this book. Many people in the industry generally perceive blockchain as a technology that's still looking for a problem to solve.
- **Internet of Things (IoT)**
  Despite the best efforts of marketing teams the world over, IoT isn't really a new thing. Many industries have been building and relying on connected devices as part of their core business for some years. What has fundamentally changed is the ability to connect these devices to back-office ERP type systems, as well as to each other, as part of broader more general business processes—IoT has moved away from being a specialist area and into the mainstream. This means that for SAP Cloud Platform, a lot of the tooling around IoT is focused on device management and integration, as well as data management and handling. Capabilities such as edge processing tools provide the integration at the device side, whereas technical,

data, and business services within SAP Cloud Platform allow IoT data and devices to be built as part of solutions. Finally, integration into the broader landscape of SAP software is provided. Many of these IoT-specific capabilities are built in turn on top of existing SAP Cloud Platform capabilities already mentioned earlier, again driving reusability and consistency for customers.

- **Machine learning**
  Machine learning is essentially the ability to train a computer system to be able to make decisions for itself. This is often achieved by supplying a significant amount of data to enable the machine to learn; for example, if you provide enough images of dogs and cat and inform the machine which is which, eventually it will "know" enough to make the distinction itself. These types of machine learning "models" and the ability to use them in your applications are delivered through the SAP Leonardo Machine Learning Foundation services on SAP Cloud Platform. At present, these provide models such as image recognition and natural language processing, as well as the ability to define, train, and use your own models. Machine learning will continue to be a massive growth area as more and more of the core ERP capabilities can benefit from automation through machine learning models. Using SAP Cloud Platform to deliver these capabilities ensures customers have the flexibility they need, without needing to make intrusive changes to their core ERP landscape.

14.5 User Interface

As you know, the UI provides the ability for a user to interact and work with a solution. In the past, the UI has often been constrained to graphical and text-based approaches, but the domain of UI has grown significantly in recent years with the advent of new technology and use cases, such as smartphones and tablets, and features such as Amazon Alexa and Apple's Siri (we'll look at the technology behind these in more detail later in this section).

As anyone familiar with UX practices knows, the UI is only one facet. Other implications of the aging SAP UX include the following:

- **User adoption**
  How many people are adopting and using the solution? Of course, functionality is very important, but often users can be influenced purely by how the solution makes them feel. This measure is often a function of the other measures we'll discuss.

- **User's task success rate**
  How often do users achieve their goal or task? Human nature dictates that many users will instantly forget about the multitude of successful task completions while focusing on the percentage of failures they experience.
- **User's time on task**
  Success isn't everything—if it takes a user an inordinate amount of time to complete even the simplest of activities, that probably can't be classed as a success.
- **User error rate**
  For every success, how many errors did the user battle? How many times did the user abandon a process or task due to issues or hitting a dead end?
- **User satisfaction**
  Although this is a somewhat subjective overall measure of the many UX facets from the user's perspective, it and the adoption measure mentioned previously are often the two most critical measures in an area that is usually heavily dependent upon subjective rather than objective assessments.

A former colleague told me that designing good UX is "advocating for the users," and this overreaching ambition is exactly why these measures can be very subjective. Ultimately, what matters above all else is that your users are happy, and how to achieve that can and will vary on a case-by-case basis.

Let's now look at how SAP has been evolving its UX story in recent years. We'll first look at how the main UI aspect of SAP's UX has changed by walking through an overview and explanation of SAP Fiori, and then expand the subject to look at other aspects of the overall UX topic.

14.5.1 SAP Fiori

In Section 14.2, we called out the headline weakness with SAP's old approach to UI, with the SAP GUI software. Yes, it's had some refinements over the years, but it isn't too different to the version we first encountered 20 years ago.

Thankfully, the negativity toward the SAP GUI hasn't gone unnoticed by SAP, who in 2013 announced and launched SAP Fiori. At its core, SAP Fiori is SAP's design language—a set of design principles that can be applied to the development of applications.

It's also important to point out that SAP has released a range of applications that follow the SAP Fiori design (at the time of writing this book, there were a total of 10,281

applications listed on SAP's official SAP Fiori apps reference library, which can be found at *https://fioriappslibrary.hana.ondemand.com*).

We'll expand more details on the various aspects of SAP Fiori in the coming sections after reviewing the most obvious change when compared to the SAP GUI.

The primary and most obvious difference between the SAP GUI and SAP Fiori is that SAP Fiori runs in the browser—the client layer has become a suitable web browser rather than a specific piece of software. If you recall the early sections of this chapter, we talked about having to install SAP GUI on 1,000 machines, and SAP Fiori running in a browser generally removes a lot of the pain around this sort of deployment, delivering benefits instantly for software provisioning and thus improving the UX for support staff in your organization.

More importantly, this also allows users to access SAP Fiori apps via a wider range of devices—if the device can run a suitable browser, you can access your SAP system. Instantly, users can run standard SAP functionality on their laptops, tablets, mobile phones, and anything else that runs a browser (e.g., SAP Fiori apps have been seen running on a Tesla's in-dash software).

Another area that SAP has faced criticism for is the complete lack of consistency across its various solutions and functions. Even in a single SAP system, such as SAP ERP, the look and feel and general UX varies greatly depending on which part of the solution you're using; finance processes look distinctly different from warehouse management, for instance. This is essentially the outcome of SAP having different development teams working in silos with no common design standards.

SAP Fiori's standard approach to UX and UI allows consistency for applications. The most common exposure to this that many SAP users will experience is the SAP Fiori launchpad. This is another topic that again warrants its own publications, however, we can take a look at the main SAP Fiori launchpad interface in Figure 14.4.

Most notable, especially when compared to the old SAP GUI, is how graphical and "simple" this new approach is. The use of tiles and a responsive framework means it looks and functions the same on a desktop browser as it does on a mobile browser.

SAP now has a broad spread of software solutions at varying levels of maturity in relation to implementing its SAP Fiori design standard; some SAP has built, while others have come through acquisitions and mergers. Not all of SAP's current business applications fully support the SAP Fiori approach, but they are very much heading in that direction. The end goal is to deliver a global, consistent UX approach for all SAP products.

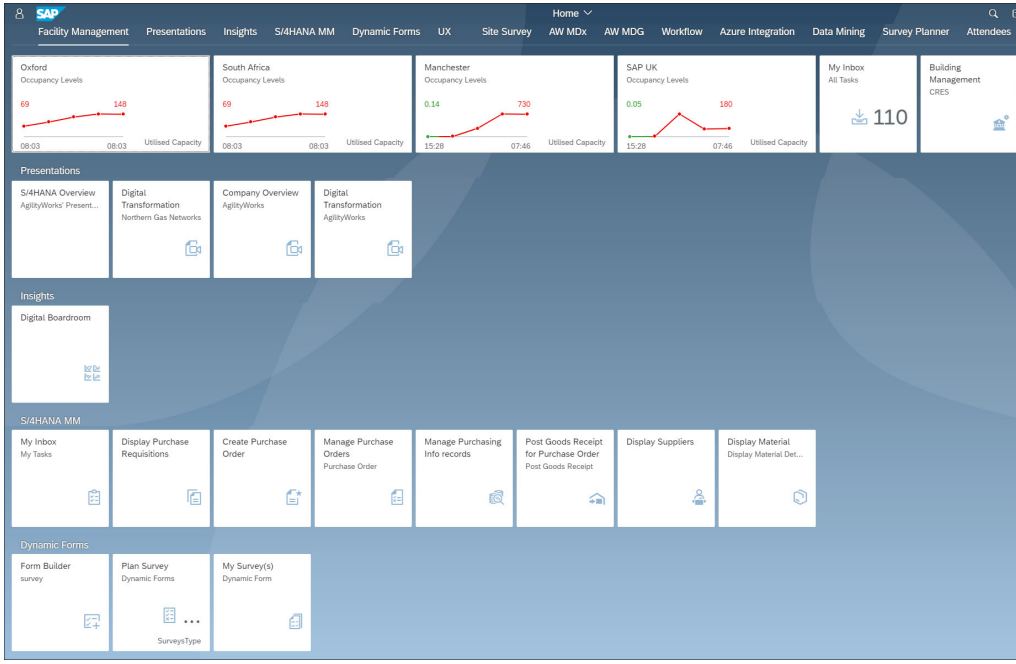

Figure 14.4 SAP Fiori Launchpad

A common design language, such as SAP Fiori, allows a user to become familiar with the general UX of a landscape, irrespective of the current task. For example, printing a pay-slip could follow a similar user journey as printing a new order for a spare part, or updating the service history for a robot could follow a similar journey to updating the engineer's own training record.

SAP is currently establishing the second major version of SAP Fiori, 2.0, into its suite of products. Many of the enhancements and capabilities mentioned in this book are part of this version, which is available for customers either deploying SAP S/4HANA 1610 and upwards or on SAP Cloud Platform Portal.

14.5.2 Artificial Intelligence and User Interfaces

Of course, SAP Fiori isn't the only aspect of UX SAP has been considering. Natural language processing (NLP) and conversational user interface (CUI) are two new capabilities that have appeared on the technology radar, and SAP is keen to include them in their own propositions.

Digital Disruptor

NLP is the ability for computer systems to respond to commands in the form of normal language or speech. Think about Apple's Siri and Amazon's Alexa as examples of using NLP. You make requests and issue commands in plain language, and behind the scenes, clever processing picks out the key criteria and context from your words and translates them into commands for the underlying application.

It's important to understand that things such as Siri and Alexa are better described as digital assistants. As their name suggests, they are digital versions of an assistant that can help you complete simple or common tasks, often using NLP as their core processing power.

Finally, if you tie NLP together with a digital assistant, you would typically experience a conversational user interface (CUI). This may be in the form of voice, text, or even writing. Crucially, the digital assistant combines NLP with a very simple and intuitive interface, which you use more like a conversation rather than issuing orders, commands, or requests.

SAP is deploying NLP, digital assistant, and CUI technology across its portfolio to augment the improvements brought by core SAP Fiori and to further improve the experience for users.

For example, in the space of analytics, a user may enter the text, "Show me the sales history for this year." This is converted via the NLP engine, and a table or chart is displayed. The user then enters the text, "For just EMEA," and a filter is applied to the data. At all points, the application is aware of the context of the user and the current data, removing superfluous steps from the process such as selecting a year, or, if the user is responsible for a specific sales area, the system would know that and only show data within that sales area without the user having to explicitly ask.

An example where SAP is quite advanced in this space is a new product called SAP CoPilot, which loosely falls within the broad bag of tricks of SAP Fiori and augments and complements the existing interface to systems. It's essentially SAP's own digital assistant, allowing users to interact with the system and data in a more natural manner, posing questions and digging deeper with natural questioning.

14.6 The Road Ahead

We've touched on many common issues organizations face when considering their current and future database and platform strategies, as well as exploring how many of SAP's current capabilities can remove many of these challenges. Let's now take a forward view of how SAP will continue to transform this area over the longer term, as well as what organizations should be considering now as part of the strategic planning.

The main message from SAP at SAPPHIRE 2018 was its ambition to deliver the "intelligent enterprise." This has quite profound and fundamental implications, specifically as SAP is looking to deliver the "intelligent suite" as the enabler for the intelligent enterprise.

Let's now take a quick dive into how SAP's intelligent suite is expected to evolve and how SAP hopes to see its software being adopted across the enterprise.

Our industry is currently in the throes of a digital revolution, or digital renaissance as SAP likes to call it. This is the move from the established, transactional world to one where humans control and manage more, and rely on computer systems to determine rules and lower level steps in the process. (Machine learning capabilities mentioned previously are great examples of this, where the machine can determine rules and best processes for a known context.)

SAP'S ambition with the intelligent enterprise is to move to the next evolution, where systems are directed by humans but have the intelligence and inherent learning abilities to achieve the outcomes with much reduced human intervention. (Ultimately, SAP and many other industry leaders expect us to achieve the final evolutionary plane in systems, with self-running organizations where computer systems have the power, intelligence, and capabilities to run almost unaided, with humans simply overseeing and supervising the outcomes. For those fearing the rise of the machines, we're still, thankfully, some years away from this.)

SAP realized that to truly deliver the first intelligent enterprises, it must embed intelligence into the core of its product suite and make intelligence a staple part of the entire landscape. This is beginning to manifest with many capabilities in the core SAP S/4HANA suite making use of machine learning, artificial intelligence (AI), and eventually deep learning to improve results and efficiency and remove the need for human interventions.

Digital Disruptor

It's useful to understand the differences among AI, machine learning, and deep learning. We've covered the first two in some detail already, with AI often being found in NLP and digital assistant technologies, while we covered machine learning when talking about the capabilities on SAP Cloud Platform used within the SAP Leonardo package.

Deep learning, however, may be a harder term to grasp and is, potentially, the area of technology likely most in line with the average person's perception of AI. Ironically, it also makes use of an approach that has been around for many years—neural networks. This is the modeling of computer systems to replicate the structure of the human brain, with many nodes interlinked with each other to provide a massive network of processing power, all of which feeds and consumes off each other. The main reason deep learning is at the forefront again is thanks to the evolution of computer hardware. Graphical processing units (GPUs) from the likes of Nvidia now have the power, especially when built into massive parallel farms, to achieve extraordinary processing power.

Whereas machine learning relies on systems learning known rules from massive amounts of data, deep learning enables systems to consume data, review the outputs, and then begin to formulate and define what the rules actually are. This currently has massive applications in areas such as health care or medicine development, and, like most technology advances, it will most likely drip down into everyday life very soon.

SAP has sensibly realized that providing all of this clever technology alone won't deliver the intelligent enterprise. Quite simply, there is too much baggage and technical debt in the current approach to SAP landscapes. The level of complexity to provide a relatively simple SAP landscape is working against SAP and its customers.

With this in mind, SAP is embarking on what could possibly be described as a fundamental re-architecting of its entire approach to landscapes. In the coming three to five years, we'll likely see SAP going back to its first principles to consolidate its offerings and deliver true simplicity and flexibility.

While not appearing to be groundbreaking on first consideration, this initiative includes some core principles:

- **Unified UX**
  SAP's challenge of a single, common UX, or at least a single consolidated UI to its

landscape briefly alluded to earlier. SAP is now heading toward SAP Fiori 3.0, and as the SAP Fiori story unfolds, one of the key outputs to support the intelligent suite will be a single, common UI layer across the entire SAP landscape.

- **Simplified, unified integration**
  Per the UX point just made, SAP realizes the current complexity and overhead when integrating various SAP products has become bloated and unnecessarily time-consuming. SAP is heading to a pure API-driven architecture, with common, simple integration scenarios available to plumb different SAP capabilities together without expending great time and effort in integration.
- **Common data model**
  Moving away from the constant need to extract, replicate, synchronize, and manage deltas of data, SAP wants to get to one true system of record with a canonical data model and the removal of constant integration of data around the landscape. Core to this is a significantly increased need for proper data governance and control.
- **API-led architecture**
  SAP is moving to an everything-as-a-service (EaaS) model, ranging in granularity from clusters of capability (e.g., analytics, for which SAP Analytics Cloud is likely to become the single solution) right down to the micro-service level, where all business logic and data access will be available via industry-standard, lightweight services.

SAP is very early in its thinking in this space. Rough landscape architectures give a hint of where SAP is heading but probably don't explain enough of the detail and, more importantly, don't consider the journey we all face. However, it's becoming more clear to see how SAP can pull together many of its current capabilities to begin laying the right foundations for this journey. We'll explore this topic further in the Conclusion.

In the next chapter, we'll move on to another major topic in data: data warehousing.

Chapter 15
Data Warehouse

Now we'll take a specific look at the data warehouse capabilities within SAP landscapes, and review how they can be used and most importantly how they are likely to evolve within the broader context of databases and platforms in the SAP world.

"Data warehouse" is a generic term used to describe any solution that acts as a large-scale store of data from many sources mostly to enable and provide analytics and reporting functionality.

Generally, a data warehouse is viewed as the enterprise-wide view of data, including data from many sources and for consumption/use by a cross-section of the organization. There is a more granular view, called data mart, which is essentially a subset of data in the warehouse that applies or is useful to a subset of the overall organization. It could be (loosely) said that a data warehouse is a collection of many data marts.

A data warehouse has been the solution that enables organizations to take their transactional data (online transactional processing [OLTP]) and transform it into a structure and form that enables reporting (online analytical processing [OLAP]).

Crucially, there has always been a clear barrier or distinction between OLTP and OLAP; that is, traditional database platforms haven't been able to handle these two operating modes within the same engine, meaning that for most organizations operating in a transactional manner, a data warehouse of some description has always been mandatory. This has primarily been to support snapshot views of information that align with the business context or a point in time of an organization's history.

Specifically, SAP's established product in this space is SAP Business Warehouse (SAP BW). Although it has been around since the late 1990s, it has evolved into the latest version known as SAP BW/4HANA, with a few other key milestones along the way. It provides SAP customers with the ability to combine, consolidate, and consume data from their enterprise resource planning (ERP) landscape with the fundamental ambition of supporting decision-making at all levels in an organization.

It's fair to summarize that current data warehouse solutions are light years away from what SAP first envisaged and how they have traditionally been viewed within organizations. Some might also argue that they have moved so far away from their original intent that they are suffering degradation in terms of performance, efficiency, and business value. Driven by many of the changes at the database and platform level (discussed previously), the world of the data warehouse has changed dramatically.

Originally, SAP BW was released purely to act as a reporting solution over the SAP ERP software. It evolved over time to become an SAP ERP data warehouse (which often sat in the shadows of a non-SAP enterprise data warehouse) and finally into a full enterprise data warehouse, servicing the entire organization.

In the early days, there was always a perception that the SAP BW software only really worked well with SAP's software, mainly because of the large amount of native integrations between SAP's software and the SAP BW platform. Customers considered it inappropriate for non-SAP data. As the technology has evolved (as we'll see in subsequent sections of this chapter) with the changes delivered through SAP BW on SAP HANA and SAP BW/4HANA, the level of openness inherent in the technology and, therefore, the ability to work with non-SAP data have greatly improved.

As well as reviewing how this fits with our business case, we'll walk through some of the most recent evolutions and concepts relating to SAP's data warehouse solutions and the changes these are bringing to how organizations make use of their data. We'll also look at what the future holds in this area, which has been quite a contentious topic in recent years as people argue for and against the continued need for a data warehouse in the modern landscape.

15.1 Business Case

If we look at Bault Robotical's use of SAP BW, it's highly typical of many customers. While its core SAP ERP and related landscape was good at capturing operational, transactional level information, it didn't provide the aggregated or consolidated view often needed to support decision-making.

Since Bault Robotical's original SAP landscape was implemented, there has been an almost constant focus on designing, building, deploying, and refining reports on top of its data warehouse. There isn't a part of the Bault Robotical business that doesn't

have its own cottage industry responsible for creating "analytics" or "insight" solutions. Most frustrating (especially for the IT department) is that often SAP BW is used as a staging area or proxy, with data then extracted out and tools like Microsoft Excel used to create reports and support decisions.

Further, because a typical data warehouse solution doesn't act as the system of record for the source transactional data, Bault Robotical has invested a large amount of time and effort in the simple act of extracting data from its systems and replicating it into the SAP BW system. When Bault Robotical only had SAP ERP as a core source system, there was some level of control and governance around what data they replicated from SAP ERP into SAP BW. As the Bault Robotical landscape grew with more SAP products generating increasing amounts of data, the approach to managing data for its SAP BW landscape became more fragmented and more of a consumer of resources.

Unfortunately, while the creation and consumption of reports on top of the data warehouse can be relatively low-impact, there is generally a significant level of effort required to get the correct data and transform it to the requisite format.

If you combine the level of effort required to extract and transform the data with the ultimate use of spreadsheets, Bault Robotical is in a situation where nearly everyone within its business, or at least the various teams, often have their own version of the same core data. While this data may originate in the SAP landscape, they end up with multiple (and subtly different) versions of it.

Interestingly, if you were to engage with many of the consumers of reports based on Bault Robotical's SAP BW data, they would generally be quite positive about their experiences and suggest that the many hundreds (likely thousands!) of reports that they have access to all add value and are crucial to support the day-to-day running of the business. Naturally, this often leads to heads butting over whose version of the data is correct.

Given all of this, there is a growing discontent within Bault Robotical with how reporting and analytics are approached (we'll come back to the specifics of analytics in Chapter 16) and, more specifically, with how the general user base approaches the consumption of data within the context of decision-making.

At the core, one of the main reasons for this discontent is the fact that no matter how complex, how accurate, or how transparent the data in Bault Robotical's SAP BW systems is, it's often out of date at the point of consumption. Due to the architecture and processes needed to enable the SAP BW capability, there is always some level of

latency between operational, transactional events occurring (and being recorded in a system of record) and the reports based on this data being available for consumption. While this isn't a massive problem for many consumers of the data, there are a number of scenarios in faster moving parts of the business where having more up-to-date information to support decisions would be very beneficial.

For example, the area sales managers within Bault Robotical's sales function receive a report at the start of each month that represents the previous month's sales performance; this is built up periodically by batch replications and transformations of data from the SAP ERP system into the SAP BW system. While this reporting approach gives some level of insight into sales performance, the latency inherent often limits decisive actions, and Bault Robotical is realizing this is limiting its effectiveness across the entire business.

In addition, the current approach to silos and keeping data and reporting split across the respective parts of the business can sometimes lead to a decision being made by one part of the business, which has an adverse effect elsewhere or simply asks the impossible of that other part of the business.

In short, while Bault Robotical accepts that it needs insight into data for both historical and current scenarios, the company realizes that to get the full benefit from all the data it captures, generates, and stores, it needs to be better at sharing it, distributing it to the right audience, and ensuring there is only ever one version of the truth. More radically, Bault Robotical is hopeful it can move away from a reliance on multiple static reports and instead do something that is more in line with intelligent insights and analytics.

15.2 Data Warehousing

We've highlighted the more traditional approach to data warehousing by looking at SAP BW in the context of our business case. It's a pattern, or architecture, that is common across the broad spectrum of the IT industry, that is, extract collections of data from the transactional side of the landscape and convert that data to a form that supports analytical processing or reporting.

In the following sections, we'll break down data warehousing by the various solutions offered by SAP.

15.2.1 SAP BusinessObjects and SAP Lumira

Looking specifically at SAP's long-established data warehouse software, as it has grown from a pure ERP reporting platform into a complete enterprise data warehouse, it has also grown bloated and arguably overcomplicated. The components around the extract, transform, load (ETL) processing and the subsequent modeling and visualization have constantly changed and been augmented to keep up with the developments of SAP and the wider IT landscape.

If we only focus on the reporting tools SAP has made available for data warehouse over the years, we can get to quite a list of options: SAP Lumira, SAP BusinessObjects Design Studio, SAP BusinessObjects Web Intelligence, SAP Analysis for Microsoft Office, and many more. The point is that this area has become very fragmented. This only serves to drive more cottage industries where different parts of the same organization might use completely different toolsets to reach the same result, which is far from efficient.

Out with the Old

SAP acquired BusinessObjects back in late 2007. As part of this solid and sensible acquisition, SAP gained access to many strong software propositions that worked directly with the SAP BW software.

This included SAP BusinessObjects Design Studio, which has subsequently evolved and has now been consumed alongside SAP Lumira 1.0, with them consolidating into a combined product called SAP Lumira 2.0.

In the interest of a fair fight, it's probably important to call out that the reporting and visualization tools SAP has delivered most recently to work with SAP BW do have great features, and the evolution through SAP BusinessObjects Design Studio to SAP Lumira has delivered a very accomplished product. Figure 15.1 is an example of a dashboard created using SAP Lumira 2.0, including some of its location-based visualizations.

SAP Lumira has two distinct and rich capability sets split between designer tooling (SAP Lumira, designer edition) and discovery tooling (SAP Lumira, discovery edition). These sit on top of the SAP BW platform and offer varying levels of complexity and control so that users can work with their data (although we're talking primarily about SAP BW here, the tooling can work with SAP BW, direct to SAP HANA, with flat files, and with other non-SAP data sources). To offer complete flexibility, it has two modes

of working with data: either through a live connection, where the data stays in its existing home and is consumed at runtime, or through data acquisition where it's loaded and persisted inside of SAP Lumira's own database. (These two methods of consuming data are a common pattern that we encounter numerous times throughout Part V of this book.)

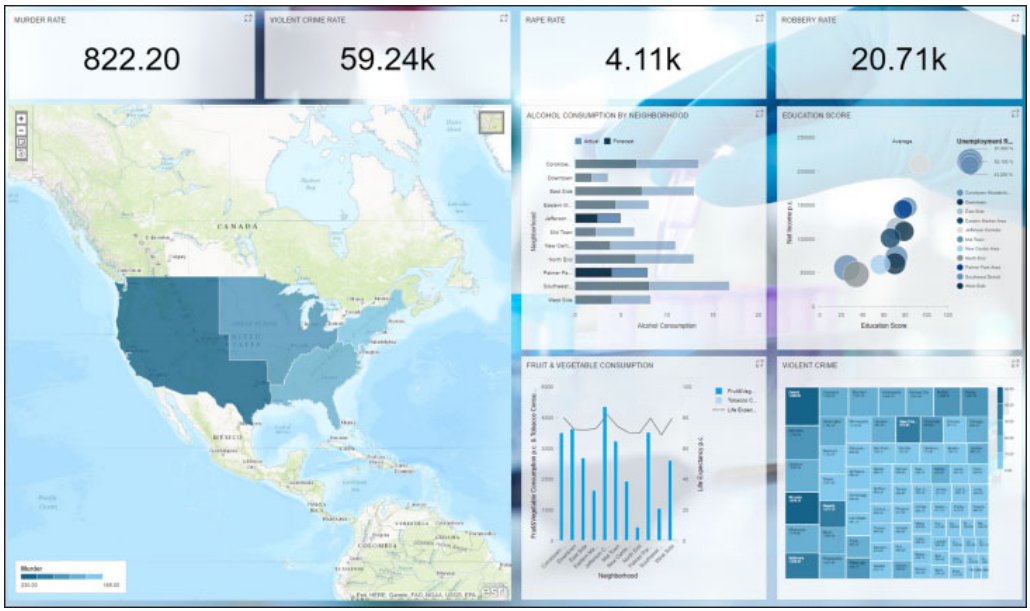

Figure 15.1 Example SAP Lumira Output

The designer tooling is aimed at experienced super-users (typically in IS) who can use a complex range of tools to design and develop connections, models, and visualizations, consuming data from various sources and performing complex modeling and consolidation of the data, before publishing content.

The discovery tooling allows business users to work with existing content and react to ever-changing demands, augmenting or changing existing content to meet specific needs. This provides agility to respond to changing line of business (LoB) needs.

With these two approaches, dashboards can be delivered for fast, repeatable results in organizations, which can be further customized by business users. At the same time, ad hoc content created by the business can be consumed and promoted back into the enterprise dashboards.

A simplified view of the architecture for SAP Lumira is shown in Figure 15.2, highlighting the three main consumption personas, as well as the fact that it can work with multiple SAP and non-SAP sources of data.

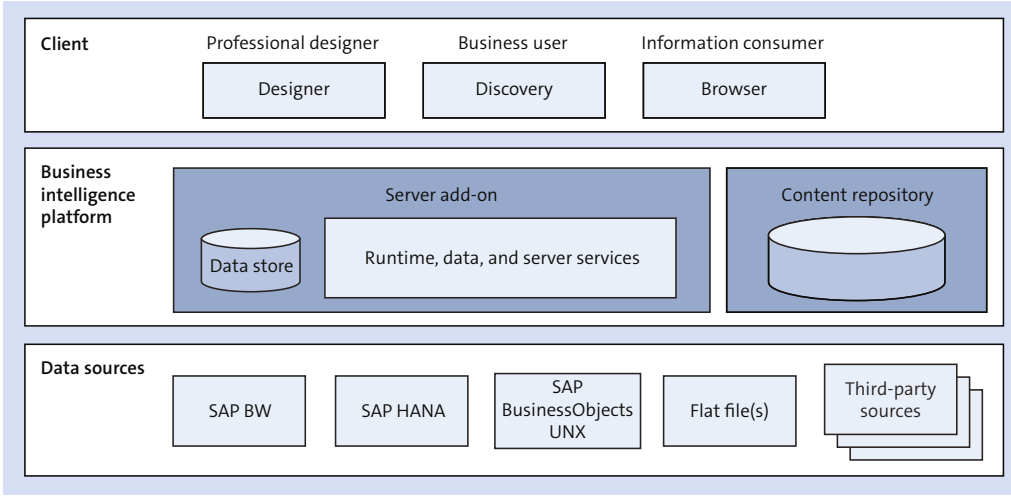

Figure 15.2 Simple Overview of SAP Lumira Architecture

15.2.2 SAP Business Warehouse

Originally, certainly from SAP's perspective, SAP BW was born to provide reporting based on the SAP ERP landscape to fill the hole in its SAP ERP software where the breadth and depth of reporting was limited.

One of the main limitations SAP BW has suffered is the latency between transactions being created and posted into the transactional database and their availability in the data. Many customers still running the older SAP BW software often talk about the flow of their data from SAP ERP to SAP BW taking up to half a day at a time; when that process is running once per 24 hours, it all adds up to a lot of time and processing power being consumed.

This is often compounded with a more nuanced challenge in that it's often difficult to envisage what data will be needed in the data warehouse by the end users, which often leads to one of two possible outcomes:

- Too much data is replicated from SAP ERP to SAP BW, leading to redundancy, increased latency, and complexity in dealing with the data (not to mention increasing costs in terms of technical complexity and size).

- Not enough data is available in the SAP BW system, leading to limited use of SAP BW, the perception it isn't adding value, and dropping adoption of the solution.

In both cases, the outcome is generally the same—users move to spreadsheets or similar software to achieve their reporting goals. and the whole cycle is repeated, with more extracts from the wider landscape into SAP BW and more manual work on top of this effort.

If we consider for a moment how data is built up in data warehouse solutions, there are two common approaches: top-down or bottom-up. In simple terms, top-down involves collecting all data required into the data warehouse from the various source systems and then gradually refining the focus, consumption, and models available for specific groups of users. In reverse, going from bottom-up revolves around taking the individual user groups' needs and working up to a full data warehouse. There are limited pros and cons of both approaches, and generally the approach is driven more by the organizational approach (which part of the business will implement reporting solutions on SAP BW first, or will it be a company-wide endeavor?).

Irrespective of the approach, the general pattern for moving data from the source system to the target SAP BW landscape has remained consistently the ETL pipeline (illustrated in Figure 15.3 as part of an overall data warehouse landscape) common to many database platforms, and built as a core part of SAP BW:

- **Extract**
  This is the act of reading data in its raw state from the source system (e.g., SAP ERP) as an extraction that can feed further into this process. Often, to feed into SAP BW, the extract tool can read data from various sources, for example, pulling both material master and sales order information out of an SAP ERP system to enable the building of a sales-focused report.
- **Transform**
  Not surprisingly, to achieve the maximum benefit from moving the data from the source system to the target data warehouse, it likely needs some level of manipulating so that it's in a form and structure that can be used effectively by the target reporting/analytics solutions. The transform process can apply transformations ranging from simply removing superfluous data or null values, through converting values from a to b via lookup tables or rules, through to combining multiple sources of data into a consolidated model.
- **Load**
  This is the tool that takes the extracted and transformed data and writes it into the target database, in this case, SAP BW.

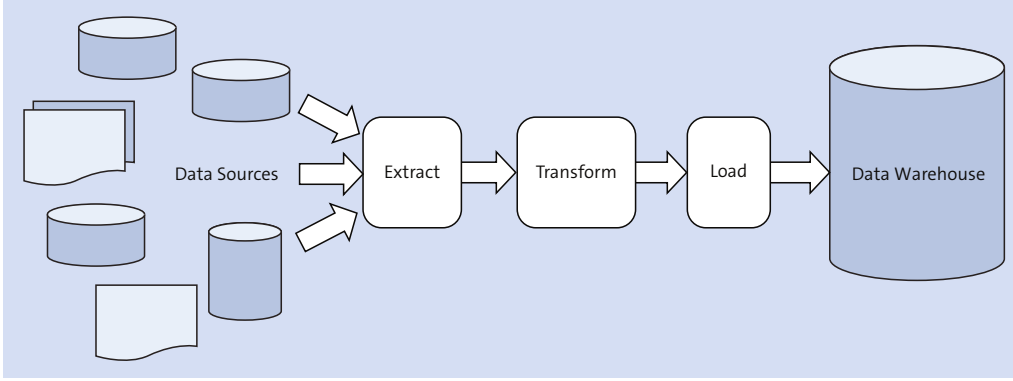

Figure 15.3 ETL Tools Shown within the Overall Data Warehouse Flow

Without getting further bogged down in this history of SAP BW and how we got here, it's worth revisiting some limitations of the traditional architecture/approach shown in Figure 15.3, as well as how SAP's evolving data warehouse solution has responded and changed.

Despite constantly enhancing, changing, and adding to the toolset and capabilities in SAP BW, it has started to creak in places. Mainly, the physical size of data in landscapes has only gone one way, and despite a data warehouse inherently being built to deal with large volumes, the sizes of modern warehouses are far exceeding what was envisaged. This has a direct impact on performance of all activities on the SAP BW platform.

Although the cost of hard drive space has continued to decrease, meaning the cost per gigabyte to store a growing set of data has come down, this is only one aspect directly impacted by the size of data in a system.

And while the toolset has evolved, as mentioned earlier, ultimately the same old process of extracting data from source systems into the SAP BW platform hasn't fundamentally changed. Combine this with the rapidly increasing size of data volumes, and many users of SAP BW are increasingly feeling the pain.

In some ways, SAP BW has become a victim of its own continued and widespread success, having to provide capabilities across too broad a range of requirements and operating methods. And while the frontend tools have come on leaps and bounds, even making the jump to full cloud software-as-a-service (SaaS) models (as we'll see in the next chapter), the underlying architecture and tooling to acquire and manipulate data is still the weak link.

There are currently two flavors of SAP BW: SAP BW on SAP HANA and SAP BW/4HANA. It's a nuanced naming difference, and hopefully you've guessed that SAP BW/4HANA is the long-term strategic platform, given that it aligns with SAP S/4HANA and the recently announced SAP C/4HANA. We'll now take a deeper look at both of these products.

Digital Disrupter

As people focus on both the cost and value of data, we're seeing a massive recognition and rethinking spread through the business and IT world of just how important raw data is, instead of it being ignored in favor of business processes. For many years, the attitude that "storage is cheap" held fast, and people worried less about the data they held in terms of size or quality. Bragging rights were formed at the size of corporate data centers. With the explosion of big data (which we'll explore in Section 15.3) in parallel with more and more businesses wanting to simplify and consolidate their processes, we're seeing a maturing attitude to controlling enterprise data. This manifests in the key areas of data quality, data governance, and data storage.

We explore these topics throughout this book in more detail, but for this chapter, it's important to understand just how crucial data has become for many organizations that traditionally treated it as a commodity. In fact, there are many organizations who are creating new value streams in their business by monetizing their data, sometimes at the expense of their existing products.

15.2.3 SAP Business Warehouse on SAP HANA

All this talk of data brings us nicely back to SAP HANA. Around 2012, SAP rebuilt SAP BW, made it capable of working on top of the SAP HANA database platform, and called it SAP BW on SAP HANA (in a similar way, they also released SAP Business Suite on SAP HANA, which was the SAP ERP software running on an SAP HANA database, and the precursor to SAP S/4HANA).

The early versions of SAP BW on SAP HANA primarily focused on performance optimization, offering improvements in modeling and analyzing data after it was in the SAP BW platform. Redevelopment of key areas to achieve this, along with the inherent performance gains of using SAP HANA as the database, offered a certain degree of improvement to the overall platform.

Migrating to the SAP HANA database platform allowed SAP to streamline some of the processes and tools used to work with SAP BW. Removing some of the redundant

layers has been a great step forward that has reduced the lag between acquiring data from source systems, making it available in reporting solutions.

However, to ensure backward compatibility and enable existing SAP BW customers to use their existing content, lots of the old, established objects and working methods that have been inherent to SAP BW remain, even when running on SAP HANA. Many customers who didn't have a performance problem with their SAP BW systems chose not to migrate to SAP BW on SAP HANA at all.

Further, a lot of the limitations around the ETL process remain; for example, customers still need to perform a lot of hard work to get the data out of source systems and into SAP BW on SAP HANA before being able to use it. And while some simplification of data models was delivered, many customers were left with a significant amount of technical baggage across their SAP ERP and SAP BW landscapes. In many cases, the effort needed to reengineer a lot of the existing content in SAP BW systems to capitalize on the new technology is too much. Some customers haven't changed their data models since they first implemented SAP BW, further increasing the number of customers who have so far given SAP BW on SAP HANA a miss.

SAP has worked through the last few versions of SAP BW to capitalize on the performance improvements SAP HANA brings (compression of data typically between a factor of 8 and 12, plus performance improvements of many hundred percent). This has been a great step to reinvigorate the data warehouse capabilities within SAP customers, but not all old baggage has been removed, and some limitations and frustrations remain. As a result, at the time of writing (fall 2018), the world of data warehouse software from SAP remains somewhat uncertain.

15.2.4 SAP BW/4HANA

To be clear, SAP HANA itself isn't a replacement for SAP BW because the new SAP BW application has been rebuilt by SAP too. SAP HANA has been a significant enabler of improvements, however, allowing SAP to deliver a solution that is now more powerful and capable when dealing with large, complex suites of data, while also being easier and simpler to work with.

This prospect of increased capability, paired with more simple processes and tooling, pretty much sums up what SAP BW/4HANA is. Released late in 2016, it's the next evolution of data warehouse solutions, and as mentioned, it's their strategic business warehouse solution. Unlike previous versions, it has been engineered from the start

to support both on-premise and, more importantly, cloud style deployments, via infrastructure-as-a-service (IaaS) providers such as Amazon Web Services (AWS).

In the following sections, we'll take a look at the key functionality and benefits of SAP BW/4HANA, as well as the migration process.

Key Functionality

The journey SAP began with SAP BW on SAP HANA by removing many of the superfluous layers between the raw data and output from modeling has been accelerated with SAP BW/4HANA. Whereas there were previously multiple artifacts needed when performing application-based modeling in SAP BW (anything ranging from 10 to 15), with SAP BW/4HANA there are only 4: InfoObject, advanced DataStore object, open ODS view, and composite provider. This reduces the complexity for SAP BW designers/developers, while also removing lots of the overhead from the actual runtime to improve overall performance and efficiency.

Picking up the point we made earlier about the physical size of databases underneath SAP BW systems, a massive change in SAP BW/4HANA is the move to more logical modeling. In simple terms, this means that data isn't physically stored in the database at numerous stages through the modeling process as it's transformed or consolidated; instead, mostly thanks to the power of SAP HANA, views are used, which don't need the data to be persisted. The transformations and consolidations occur at runtime in the SAP HANA engine.

This use of logical views in SAP HANA reduces the storage needed and capitalizes on the performance benefits of SAP HANA's processing engines. A final benefit is that increased agility is provided to the business, as changes to reporting needs are easier to make when all that needs to be updated is an SAP HANA view, and you don't have to change/manipulate a large portion of existing, persisted data in the database.

We touched on application-based modeling earlier, however it's also possible to model direct via native SQL with SAP BW/4HANA. This provides opportunities for organizations that may currently have distributed data warehouse landscapes across SAP BW and non-SAP data warehouses to consolidate onto the one platform. You can retain the power and flexibility of the two approaches but simplify the IT landscape needed to provide those capabilities.

This combination of both application-based modeling and native SQL in the one platform has a further benefit, in that the artifacts created via both approaches can be cross-consumed. When you create something via the application modeling tools, it's automatically generated at the SAP HANA layer as a view, which in turn can be used

directly in native SQL. This again offers improved flexibility and also provides better reuse of artifacts when modeling content. It provides a converging toolset for users to model using the most appropriate, or preferred approach, without the need for rework or duplication.

What's Right for You?

Reading this, you might be wondering whether to migrate from SAP BW to SAP BW on SAP HANA or to move to SAP BW/4HANA (or even completely remove an SAP BW solution from your organization).

Right now, there isn't a single one-size-fits-all answer. Generally, if you do need a data warehouse solution, SAP BW/4HANA is probably the logical platform to go for, however, it isn't quite as mature as the SAP BW and SAP BW on SAP HANA solutions it's replacing (yet).

And certainly, even with SAP S/4HANA providing the consolidation of OLTP and OLAP into one database, the reality is that you'll likely still need some element of time-sliced data and hence need a data warehouse of some description.

Ultimately, if you want to implement an SAP BW solution, SAP BW/4HANA is the logical choice.

We'll talk about big data in Section 15.3, however, it's worth mentioning that SAP BW/4HANA has inherent capabilities to integrate with big data sources. Primarily, this allows you to acquire data from data lakes running on Apache Hadoop using something called the Spark SQL adapter.

To be clear, "acquire" in the preceding paragraph actually means virtualize—a combination of the Spark adapter and a view within SAP HANA allow SAP BW/4HANA to work with the data from Hadoop without pulling it across and persisting it in the SAP HANA database.

Migration

If you're now wondering what a migration from your existing SAP BW solution to SAP BW4/HANA could look like, we'll briefly explore some of the main options and considerations, boiling down the two key options of either migrating or reimplementing.

The main deciding question often boils down to whether your current data model is fit for purpose. This is largely irrelevant of the current and/or target technical

platform or versions of SAP BW; however, it's most important as there is simply no point migrating or porting content that is no longer useful to the business across to a shiny new platform. All you'll gain is faster access to redundant information. If, like our case study Bault Robotical, your data models are far removed from the current and future needs of the business, probably this is a good time to reimplement your SAP BW landscape.

Even if your data model is fit for purpose, you now need to consider the technical fit of your current SAP BW system. If you haven't moved from SAP BW to SAP BW on HANA, you'll face a significant level of effort along the journey. Initially, you need to get your existing content updated so that it complies with SAP BW on SAP HANA version 7.5. Depending on your starting point, this could be a big task (if, for instance, you still have a lot of models based on the older SAP BW 3.x platform). After you've adjusted your content and deployed SAP BW 7.5 for SAP HANA add-on, you should now be able to switch to SAP BW/4HANA.

If the preceding is too daunting, or you want to take advantage of a new SAP BW platform by reimplementing, the path is much easier. Of course, it isn't a simple case of standing up a new (empty) SAP BW/4HANA system because the business will need access to content much as they did before. Sometimes, you can make use of the limited good data and models in your existing SAP BW system, which can be migrated on a small scale across to the new platform, leaving the redundant content behind.

We mentioned earlier in this chapter that sometimes there are numerous data warehouse solutions in place. The reimplementation approach also offers the ability to consolidate these scenarios where there are multiple data warehouses in place. One of the main benefits of this approach, apart from the aforementioned simplification and reduction in data size, is the overall reduction of complexity and cost in the IT landscape, as it's physically consolidated.

The very high-level options around the migration path to SAP BW/4HANA are shown in Figure 15.4, to summarize what we've just described.

There is another option to get to SAP BW/4HANA, which is known as Project Blueberry within the world of SAP. First making news mid-2018, SAP announced it would be offering a pure SaaS version of SAP BW/4HANA, initially aimed at small- to medium-sized customers.

As with any SaaS solution, SAP wants to offer its customers the simplicity of consuming the SAP BW/4HANA software without worrying about the underlying infrastructure and systems.

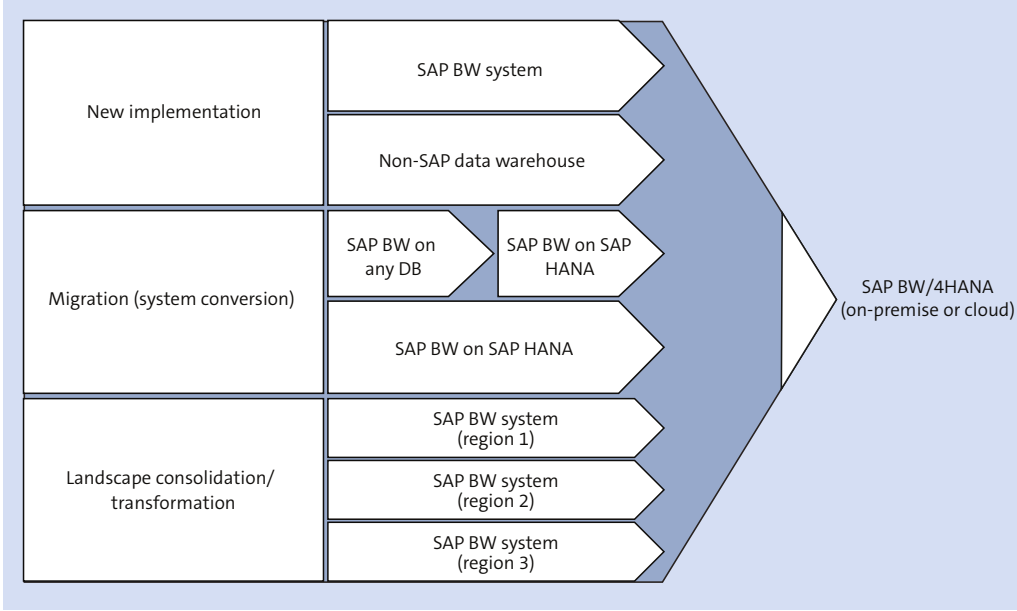
New implementation
SAP BW system
Non-SAP data warehouse
Migration (system conversion)
SAP BW on any DB
SAP BW on SAP HANA
SAP BW on SAP HANA
Landscape consolidation/ transformation
SAP BW system (region 1)
SAP BW system (region 2)
SAP BW system (region 3)
SAP BW/4HANA (on-premise or cloud)

Figure 15.4 Paths to SAP BW/4HANA

The data warehouse software used is exactly the same as that found in the normal SAP BW/4HANA solution; however, Project Blueberry is likely to see more new features added more often, again in a typical cloud model (with SAP setting the expectation, we'll see innovation and evolution delivered via a quarterly release cycle).

Aside from removing some of the overhead and associated costs of running your own business warehouse landscape, the big benefit of Project Blueberry is its native integration with other SAP Cloud Platform solutions, such as SAP S/4HANA Cloud, as well as other non-SAP systems. It also has native integration and is a logical partner to SAP Analytics Cloud software, which is also delivered via an SaaS model.

15.2.5 Embedded Analytics

Before we leave the data warehouse topic behind, we should also look at another development that has been born out again thanks to the move to SAP HANA technology.

One of the major use cases for a data warehouse system is to support operational analytics; in fact, this is where SAP BW started as a way of reporting on SAP ERP systems,

as we mentioned right at the start of this chapter. As a result, many SAP BW systems have a significant proportion of their data and models dedicated to providing this capability. This is often the biggest contributor to the regular, overnight refreshes of data from SAP ERP to SAP BW systems, which has become a massive overhead for most organizations.

With SAP S/4HANA, SAP delivered a capability called embedded analytics, which provides the still-needed operational reporting but without the need to physically move data from SAP ERP to SAP BW. With SAP HANA as the underlying database, real-time operational reporting can be delivered within the SAP ERP software. This is delivered via standard SAP Fiori analytical apps, alongside the operational and transactional applications within the SAP ERP system.

This has big benefits in that the SAP BW system no longer needs to replicate the large volumes of low-level transactional data to deliver operation reporting; instead, it allows organizations to use SAP BW more for management and strategic reporting. This also reinforces the single version of the truth approach, with only one version of data held in the landscape. In addition, the need is reduced for users to extract data and meddle with it in spreadsheets, as the embedded analytics tools provide the capability to query and build ad hoc reporting solutions in place, often without the need of IT. Business users are empowered to manage their own reporting needs in the operational world, too.

Embedded analytics does have limitations. The main limitation is where users need to merge operational data with other, external information, which is becoming an increasingly popular scenario, as we'll see shortly in the next section.

15.3 Big Data

Let's get a common perspective down early on in this section: SAP doesn't necessarily equal big data, despite many SAP systems generating and storing quite significant volumes of data in their database. There is an important distinction between *big data* technology and big data.

That's not to say an organization running SAP across its business wouldn't generate or need to work with big data, just that its quite likely (for now at least) that big data will come from systems running in parallel to the SAP landscape.

We touched on the use of Hadoop earlier, and this is one of the more common repositories for true big data. This comparatively cheap, highly scalable platform allows for

truly astronomical volumes of data to be stored and accessed. Hadoop is used by many organizations to store very low-level data, such as from IoT sensors. They can retain and use the data in other scenarios, such as reporting via SAP BW, without the high costs that could be incurred by placing the data into the SAP BW system's own database.

The power of big data typically comes when it's combined with other data, such as structured operational information coming from an SAP ERP landscape. Imagine a scenario where an SAP ERP system stores data relating to the attributes of production machines in a factory. This SAP ERP system will be generating and capturing various information relating to those machines, ranging from financial-related figures through to expected efficiencies or maintenance and service records.

The output of the machines will be captured and stored too, allowing the business to understand what they are producing, how long it took, how many raw materials went in, how much energy was consumed, and so on. Lots of this information is at quite a high level of granularity. For example, the overall resource consumption might only be captured at the level of the entire factory and be based on utility billing information.

The organization might notice that, over time, one of a number of identical machines is less efficient that the others; its output isn't at the same level or quality. With increasingly complex machinery, there is little insight or intelligence that can be gathered by simply looking and measuring input and output to this machine. An option could be to fit the machine with many small, low-granularity sensors that read and record measurements for any number of measures, each capturing a reading every few milliseconds. If the organization takes this approach across its entire production facilities, it will be generating significant volumes of data with the logical destination a repository, such as a Hadoop cluster.

So now, the company has a good handle on operational throughput and measurements, as well as a massive amount of low-level data stored elsewhere.

The logical next step is to somehow combine these differing planes of data and try to determine insight. This is an increasing area of focus for business warehouse systems, where users can review production data alongside large volumes of sensor data. Trends can be identified, and with the correct modeling, users may be able to identify the very minor differences that would explain why supposedly identical machines perform differently.

To do this, the SAP BW system must make use of connectivity to and virtualization of the large volumes of data often stored within a data lake. With capabilities such as SAP Vora and SAP Data Hub, users can orchestrate and work with these disparate sources of data in the SAP BW system. This extends the reach of both operational and strategic reporting and allows a user to navigate from a very high level down to a very low level of granularity.

With the correct models and connectivity in place in an SAP BW solution, a user could do the following:

- View a reporting dashboard that represents the performance of an entire factory.
- Drill further to information about elements of the workforce (by integrating into SAP SuccessFactors and SAP S/4HANA software).
- Maintenance plans and future schedules could be both reporting and planned; individual machines could be reviewed and compared to others over time.
- Real-time dashboards could pull together a single view of a slice of an organization, showing historic, current, and future trends and information all in one place.

This is a very powerful proposition.

Big data means so much more in this context, within an SAP landscape where there are many different sources of data, representing different levels throughout the landscape.

While it might not be the right approach to then use SAP BW software to visualize and represent this vast information (Chapter 16 details options in this area), SAP BW is key to enabling the consolidation and integration of these various data sources. Further, with the move to SAP HANA as the underlying database, along with its many data acquisition methods, it becomes the cornerstone of a solid enterprise-wide reporting and intelligence strategy. As data volumes and sources continue to grow, the boundary between pure business warehouse and analytics solutions will likely become more clear, with SAP BW/4HANA evolving to be more of an enterprise data warehouse than ever before, while it will actually physically store less data than ever. How's that for ironic?

15.4 The Road Ahead

We alluded earlier to the question of whether a data warehouse such as SAP BW will always be needed in an enterprise landscape, and we suspect for some time it will.

While the improvements we've touched on across the chapters in the database and platform section of this book propagate out and change how organizations work with their data, there will be some time before we can completely engineer a landscape that doesn't need some sort of data warehouse. Maybe we never will.

Regardless, the SAP BW/4HANA platform looks to be the way forward for a significant number of years. SAP has taken it back to bare bones in architecture, as well as streamlining the tooling and objects used to develop content and make use of the SAP BW solution in a modern SAP landscape. This lean approach will likely continue for many years.

Certainly, SAP still has some way to go before SAP BW/4HANA reaches full maturity in terms of features. It's also worth considering that there is no legal link between SAP BW and SAP BW/4HANA, and hence just like the technical migration throws up some challenges, customers will need to enter into a completely new contractual relationship with SAP to move to the new software.

Further, we'll likely still need the ability to review information from a point in time from the history of an organization, maybe prior to a large organizational or financial restructuring, which is currently something most sensibly provided by a data warehouse capability.

Let's also not forget the close relation of SAP BW and analytics (discussed in Chapter 16), which often has a heavy dependency on a data warehouse to act as one of many sources of information to drive the analytic processes and solutions.

Again, as we move to a world where all of SAP's products are running on the SAP HANA database platform, the ability to work with large volumes of data in a data warehouse becomes much more efficient.

On top of all this, as big data becomes increasingly prevalent, and indeed bigger and bigger, the ability to pull various large-scale data sets together in a state somewhere between raw and completely transformed will increase.

Finally, many organizations are really waking up to the potential of both consuming and providing data externally to their own organization.

We expect the ambitions and role of the data warehouse will become more focused and specific to acting as a repository of data. It will still retain its many (refined and renewed) capabilities in the general ETL arena, but the responsibility to then report and analyze that data will be promoted to SAP's analytics solutions.

This does throw up one more issue of whether pure SAP HANA enterprise (i.e., the full SAP HANA database platform) could be used instead of SAP BW, with all analytics and

reporting handled in the requisite software. Right now, SAP HANA is lacking more than 20 years' worth of application modeling capability that has been built up into SAP BW. For now, SAP BW/4HANA is still the logical choice to service the business warehouse need alongside an SAP ERP landscape.

With this, many of the current solutions from SAP for reporting will likely reach end of life, which might bring some consternation from those individuals who have made a healthy, stable career from some of these tools. However, the IT managers and business leads questioning the need for overly complex and ever-expanding landscapes will be glad of the rationalization of this tooling.

One thing is absolutely clear—never before has data been such a fundamental part of the modern enterprise, and likely the organizations who can best capture, refine, manipulate, and generally capitalize on the data and their partners' data will be the ones who continue to thrive and grow.

We're going to dive deeper into the topic of analytics next: After you've built your data warehouse and Big Data repositories alongside your operational, SAP ERP landscape, what can you do with all of that data to gain insight and support decision-making?

Chapter 16
Analytics

Following our deep dive into pure data warehouse and the previous look at databases and platforms, the next stop on our journey will explore the topic of analytics, that is, what to do with all the data we're building up, and how to turn it into value, insight, and business advantage.

We've devoted a lot of time so far to the creation, acquisition, storage, manipulation, and general management of data. We're now going to build on those foundations by exploring the various ways of releasing value from the data within the loosely defined topic of analytics.

Historically, certainly within the world of SAP, there has been a somewhat blurred line between data warehouse solutions and analytics solutions (we touched on some content in the previous chapter that could just as easily have resided here). For some time, reporting was bundled alongside data warehouse activities and analytics manifested as looking at reports in SAP BW and meddling with data extracted to Microsoft Excel or similar.

In general, businesses did not focus on being proactive and trying to determine what the future might hold; in fact, more often than not, most businesses didn't take too much of an interest in what was happening in real time. Energy was expended reporting on what had already happened.

While this focus on past or historical information, usually delivered in the form of static reports, allowed for some level of trend analysis, it didn't really enable businesses to make full strategic decisions for their future. Neither did it allow for short-term, tactical changes to help deal with real-time issues or opportunities.

Aside from the timeliness of information, the other key barrier to extracting maximum value from information was often the lack of context—other, pertinent information that, when combined with the core reporting information, allowed for better insight. For example, if our sales managers can also combine weather information,

they may be able to gather the insight that with freak increased temperatures, sales of ice cream go up. Without that extra context, all they have is a spike in sales for a product line.

In the previous chapter, when we explored data warehouses, we learned how various capabilities in SAP's latest technology platforms and software provide multiple methods to acquire, combine, model, and generally work with data. While visualizing that data (through products such as SAP Lumira) begins to encroach on the realm of analytics, there is so much more that can be done.

In the following sections, we'll look at the general topic of business intelligence (BI), sometimes confused or at least used interchangeably with data warehouse (despite meaning different things), and the products SAP provides to support planning, decision-making, and what-if analysis. In many ways, this will build on some of the previous content by taking a deeper dive into the reporting and analytics solutions linked closely to traditional SAP BW, such as SAP Lumira. We'll also expand into more specialized tools such as SAP Business Planning and Consolidation (SAP BPC) and SAP Analytics Cloud, which deliver true analytical capabilities.

Many of SAP's latest analytics products have elements of real-time and what-if capabilities, moving things on so that customers can stop being reactive and instead focus on current insights as well as being proactive and looking at what the future might hold. With these capabilities, our sales managers might be able to review past sales information alongside future weather forecasts to be able to predict spikes in demand for ice cream in advance, laying plans to capitalize on such a scenario for the benefit of the business.

16.1 Business Case

Talking about business benefit, the teams within Bault Robotical who currently make use of their existing reporting and analytical solutions have little to share. While Bault Robotical has had an SAP BW solution in place for many years, it has focused on reactive scenarios and static reporting.

Every day, information from various parts of the business is extracted from its business application suite and pushed into the SAP BW platform. As mentioned in the previous chapter, this is often only the first step in their users trying to generate some level of insight or model analytical outcomes.

With an inherently reactive approach to the available data in their data warehouse, typically any effort deployed results in less than satisfactory results. Bault Robotical has thousands and thousands of different reports (often more than 50 subtle variations of the same core information because individuals have requested tweaks).

The nature of Bault Robotical's business and industry focus suggests the company should be able to capitalize more effectively on the large volumes of data at its disposal, which is a real frustration for the users because, quite simply, it doesn't.

Leads across various parts of Bault Robotical's business feel they are making decisions without really understanding the implications; they don't feel that they are able to look to the future by considering and learning from the past. And despite many of the business users being somewhat guilty for requesting the many thousands of reports currently in circulation, most actually admit they don't rely on them, and, generally, the signal-to-noise ratio has gotten to the level that they mostly operate with disregard to their own reporting information.

Where they do try to work with reporting outputs, most users end up doing further manipulation in other software. While Bault Robotical can count its reporting solutions in the thousands, there is a fear that the business is mostly run on millions of spreadsheets and local databases.

In summary, the business simply needs better insight and information to help form and influence decision-making. The company believes it mostly has the right raw data or can at least acquire what it needs, but the company has very little confidence that this data is turned into anything really useful out of the existing SAP landscape and is looking for something to provide proper insight and intelligence into its business. As a result, Bault Robotical weighs their options: an on-premise implementation of SAP BusinessObjects BI, a cloud implementation of SAP Analytics Cloud, or an array of other options, which we'll discuss throughout the chapter. Ultimately, we'll see how the company could settle on a hybrid, bimodal solution to cover its needs.

16.2 Business Intelligence

As likely the broadest topic within the realm of analytics, business intelligence (BI) can cover a range of capabilities from simple reporting, through predictive what-if modeling and planning activities, to more niche functions such as process mining and text mining.

Ultimately, as the name suggests, the ambition is to take a range of information or data and derive some form of intelligence from it. Often, the term "insight" is used interchangeably with "intelligence," and it's a fair indication of the ambitions found within this area.

With most organizations generating and acquiring increasing amounts of data, as well as numerous other sources of data available to those who require it, it's a logical and sensible conclusion to expect business users to want to extract some level of insight from all this data.

Often, this insight is used to help refine, enhance, or develop existing processes, products, or solutions in place within a business. The analytics functions and software are used to clearly evaluate historic and current data and support a wider view of the business and broader context to support decision-making. Often, the insight can be used to generate completely new opportunities in markets or industries, with the information used to offer some level of analysis to support such decisions.

Such decisions can equally apply to short-term operational challenges as they can to long-term strategic planning. Often, the toolsets can be used with both horizons; however, the content, scale, and volume of data used will vary dramatically. Ultimately, it's often the case that the more data points and varied information used to feed into analytical-based decisions, the higher the probability of reaching an accurate answer.

There are two distinct approaches to BI, often simply referred to as traditional and modern. And as we'll see later in this chapter, there is a third approach that combines the best of both, known as bimodal BI.

16.2.1 Traditional Business Intelligence

The traditional approach is often all about enabling access to data, which entails reporting and dashboarding capabilities. Most organizations have an established approach to disseminating reports at regular intervals (daily, weekly, etc.) and often, this is enabled by the central IT function.

Despite being called *business* intelligence, it's often owned and provided by IT. Given that most requirements are driven by business audiences, this creates a somewhat static and reactive approach to creating, curating, and publishing the content.

In terms of content delivery, users often use a central portal, such as SAP Enterprise Portal, to access the published content. Often, many reports are generated and

pushed out for consumption, however, there is no guarantee they are consumed—many organizations end up with lots of orphaned content that is no longer suitable for use. These orphaned reports consume both processing power as part of their generation as well as storage for the underlying data and associated models.

Out with the Old

With a typically siloed approach to modeling and structuring the data in the underlying data warehouse, data in traditional BI is often aligned to business functions such as procurement or HR. Coupled with the "pre-SAP HANA" need to persist various layers of transformed data and the overnight data refresh from systems of record, traditional BI systems are often considered to be inflexible.

Having so far painted a relatively negative view of traditional BI approaches, they do still have a part to play in an overarching BI strategy. With careful curation and a more modern approach to modeling and persisting data in the underlying data warehouse (further enabled by SAP HANA as we saw in the previous chapter), the traditional approach is often the most appropriate way to deliver the core, day-to-day reporting that enables users to gather general insight into performance within their enterprise.

However, and this is where we hit on a difference between pure BI and analytics, with the traditional BI content, there is often no ability to drill down or cross-navigate from the reporting content into some related or supporting contextual information. Quite simply, there is often no ability to analyze the content.

16.2.2 Modern Business Intelligence

In stark contrast to the traditional approach, one of the core tenets of modern BI is the ability to enable a self-service approach for consumers of information. In other words, the responsibility for delivering the reports and insights moves from the hands of the IT department to the business; the people who have the query and need to find an answer are empowered with the tools and capabilities to self-serve.

Aside from the obvious advantages of removing a significant workload from the IT department (who can then focus their resources and efforts elsewhere), the modern approach delivers significant improvements to flexibility and the business's ability to respond to changing needs.

To achieve this, there are two important things that must be in place:

- The right tooling to enable and empower users who typically don't have a strong IT or data analytics background to be productive and achieve the self-service promise
- Availability of the right spread and granularity of underlying data that can feed into the queries of the business users

We'll shortly look at some of SAP's software that aims to answer the first point as we progress through this chapter; for the second point, we should think back to some of the wider technical and architectural changes SAP is deploying across its database (SAP HANA) and data warehouse layers, which contribute to easing access to an organization's wide range of data sources, not to mention those from other external sources.

With access to the full range of data (of course with the correct security and authorizations in place), a user can then explore the data and almost instantly create reports, dashboards, and analytical answers to their own queries. This is a very powerful proposition.

Of course, giving all users complete free reign to create reports and use all data isn't without challenge. Primarily, users must be empowered and trained to make best use of the applicable software; they will also likely need some level of semantic and contextual information to wrap the data and help them understand it. Otherwise, all that happens is you move the cottage industry of random reports from spreadsheets to modern BI tools.

If done correctly, the self-service approach enables the right outcomes without the users needing to know coding, and it also removes the dependency on spreadsheets and local databases. Queries and reports will now be based on a single version of the truth held in the organization's business suite and data warehouse platforms.

Digital Disrupter

We can now take modern BI further, with broader considerations such as data lakes, machine learning, and predictive analytics (which we'll explore more fully later in this chapter). In addition, again thanks to advances in database and data integration technologies, we can begin to work with a more varied range of data types. Whereas typically traditional BI focuses on structured data, modern BI tooling provides the user with access to unstructured data, information from social media, Internet of Things (IoT) sensors, real-time event streaming, and so many other sources. This topic deserves a book all its own to fully do it justice!

Suffice to say modern BI, like other leading-edge areas of software, is seeing a continued explosion in terms of capabilities and use cases. The challenge then is how to manage all these options within an enterprise environment where continuous change isn't necessarily a good thing. There needs to be some way to manage the core, stable elements of BI capabilities and needs, while also ensuring the business has the flexibility and agility to respond to and capitalize on opportunities without risking or disturbing the core. No prizes for any readers expecting us to jump to a section on bimodal BI now.

Before we do that, there is one last consideration, and a chance to take a brief look at some of SAP's latest software in the data space. The consideration, especially for modern BI approaches, is how to manage the preparation of your data.

You may have data lakes across Hadoop, Amazon Web Services (AWS), Microsoft Azure, and so on; external sources such as social media or public application programming interfaces (APIs); and all the standard and indeed custom data within your business processes. If so, you need some way of orchestrating and preparing those sources to ensure you can maximize their value in your data warehouse and BI layers.

SAP has been advancing its software significantly in this space recently with products such as SAP Data Hub and the wider package of capabilities known as SAP HANA Data Management Suite (HDMS) complementing the already existing SAP BusinessObjects BI Suite (which we'll explore in more detail shortly).

SAP Data Hub

All through Part V of this book, we've repeatedly discussed the varied and complex landscape around data provisioning, acquisition, and consumption. The simple fact is that dealing with data in organizations has become a significantly challenging activity. SAP believes the answer to this is the new SAP Data Hub software.

Primarily, it's a solution that allows you to orchestrate and manage data flows, data integrations, and data preparation, pulling data from various sources, including your own internal landscape and of course external sources. The data can be transformed, combined, and ultimately pushed onwards to SAP BW processes or into data services jobs, among other things.

The core tooling has a similar feel to many of SAP's other process-based solutions, with a highly visual approach to modeling and developing data flows.

As well as offering the low-level orchestration and management of data flows, SAP Data Hub is built with features that recognize the challenges of managing data across distributed, complex, and mixed landscapes. This is another example of SAP acknowledging that not all of its customers have only SAP software and that the number of sources and targets for data continues to expand. Some of the primary capabilities are as follows:

- **Data orchestration**
  Just like other workflow or process style solutions, SAP Data Hub allows you to chain together multiple steps in a process with branches/splits and joins as necessary. This allows you to build a purely data processing application that can handle the range of tasks needed to acquire, prepare, and manage data in a consolidated manner.
- **Modeling**
  Including artifacts such as destinations and data sets, you can get to a visual representation of the data flows in your organization, showing where the data comes from and where it heads, how it's manipulated, merged or transformed, etc.
- **Governance**
  With so many artifacts and data flows, ensuring that control and governance are provided is key. As a result, the platform includes the tooling needed to apply the correct controls as necessary, ranging from security and access through to lifecycle management.
- **Discovery**
  To follow the self-service approach mentioned in the BI world, SAP has added similar patterns at the data processing level, so that users are able to search for and find the data sources and flows they need, with metadata stored against the artifacts providing a semantic context.
- **SAP Vora**
  The final, crucial cornerstone is the use of the SAP Vora database tooling to ensure SAP Data Hub can work with a range of database and big data providers and different types of data engines, which can help users dig into the raw source data and work at the SQL level

SAP HANA Data Management Suite

We've talked about many different capabilities from SAP in recent chapters, all related to the core theme of data. Not surprisingly, there have been an increasing number of products in this space from SAP and, as a result, some level of confusion.

In a bid to resolve at least some of this, early in 2018, SAP announced the SAP HANA Data Management Suite.

SAP HANA Data Management Suite isn't a new product, but a bundle of existing software from SAP that complements and works together to support customers working with data. It comprises the following:

- **SAP HANA**
  The core database platform technology.
- **SAP Data Hub**
  A data orchestration and processing tool.
- **SAP Enterprise Architecture Designer**
  A tool to capture (as the name suggests) enterprise architecture, patterns, and designs.
- **SAP Cloud Platform Big Data Services**
  A grouping of services and capabilities supporting integration to Hadoop for managing big data in an SAP landscape.

These products come together to offer customers the full range of capabilities needed to manage their data, supporting and complementing SAP BW and SAP BusinessObjects BI capabilities as part of its broader modern BI approach.

Before we look at how SAP's broad software in the BI space comes together, let's explore the final approach to BI to help frame how SAP is positioning its offerings.

16.2.3 Bimodal Business Intelligence

With the modern, agile approach to BI offering the flexibility needed by customers complemented with the traditional BI aspect providing the necessary stable, core reporting, we arrive at bimodal BI.

We've already explored both approaches, so we don't need to delve too deeply, but the key point is that both approaches work in tandem ensuring the organization has access to the full range of reporting and analytics capabilities needed. It's the very definition of the best of both worlds (at least in the world of enterprise BI).

To round out this section on BI, we'll now review some of the key software capabilities from SAP that are used to enable BI. The full list of software options in this space is rather long, and, as a result, customers can often end up with numerous solutions in place. Keeping our focus on SAP's latest and greatest, we'll limit our view to the main go-to BI propositions from SAP: SAP Analytics Cloud and SAP BusinessObjects

BI suite. Then, we'll finally take a look at an offering that is aimed at helping users navigate their way through the ever-expanding options for analytics.

SAP Analytics Cloud

Despite there still being a significant level of investment and solutions available in the on-premise world of BI, SAP isn't neglecting analytics in its broader march toward cloud dominance.

Initially, the SAP Analytics Cloud platform was targeted more at the modern BI side of things, with capabilities focused very much on self-service and real agility to generate reports and insights.

In a short space of time, it has evolved significantly and now includes four core capability offerings:

- **Business Intelligence**
  Generally deployed in parallel to the on-premise SAP BusinessObjects BI suite, SAP Analytics Cloud has capabilities to support the modern BI elements mentioned in Section 16.2.2. As it's a cloud platform and therefore accessible via a browser, the overall experience is very intuitive and has been deliberately built to enable users to extract maximum value.

  While this is firmly at the center of SAP's analytics portfolio, it takes advantage of the ability to connect to both SAP and non-SAP sources. Live connections can be pointed at SAP HANA databases, for example, with data pulled across in real time to feed into analytical models. SAP Analytics Cloud also has the ability to store data locally, so it can support flat files or ingestion of data from remote APIs or other sources.

  In line with its modern BI aspirations, SAP Analytics Cloud includes tooling that supports discovery of data to support agile working, and it includes collaboration features that make it easier for distribute teams and users to work together on analytical content and modeling.

  At its current maturity, the real weakness of SAP Analytics Cloud is that it doesn't have a massively powerful "engine" under the covers. While it can consume, transform, and consolidate data from multiple sources, it doesn't have the full range of power available within the SAP HANA platform itself. As a result, we often find SAP Analytics Cloud is deployed alongside an SAP HANA platform (often within SAP Cloud Platform), which acts as the data acquisition, preparation, and staging area using a combination of SAP HANA tools and raw custom coding. As SAP Data Hub

becomes more mature and prevalent, this will likely displace the need for this manual equivalent and shore up SAP Analytics Cloud's capabilities.

- **Planning**
  We'll explore the full enterprise performance management (EPM) topic in Section 16.3; however, it's worth understanding that SAP is pushing more of this functionality into SAP Analytics Cloud. While the capabilities aren't at the level of SAP BPC yet, it certainly shows SAP's intent to push more people toward its cloud offerings.

  The current vision is to bring the agile analytics within SAP Analytics Cloud alongside the full planning capability, which provides for an all-encompassing approach when combined with the collaboration and discovery capabilities in SAP Analytics Cloud.

  As it stands, planning within SAP Analytics Cloud is comparatively immature, however, customers are beginning to make use of it. Often its place is where a customer doesn't already have a significant investment or complex landscape that revolves around SAP Business Suite or existing EPM solutions.

- **Predictive analytics**
  Again, we'll revisit this broad topic more generally later in this chapter (Section 16.4); however, it's an important part of SAP's approach to delivering SAP Analytics Cloud because predictive analytics can deliver value, especially when paired with analytical solutions.

  The core of predictive processing in SAP Analytics Cloud is to provide common predictive models, such as regression and time series, to help inform decisions and give users a view of what-if scenarios based on their historic and current data.

  Models can be built that acquire data, again using the many methods available to SAP Analytics Cloud for both live and persisted data, and then the data can be run through automated model builders that include the algorithms available to determine an answer. Users can then extend and customize these models and generate different possible outcomes to help fully answer questions posed.

- **SAP Digital Boardroom**
  Although SAP Digital Boardroom is classed as a product in its own right, it's in reality an extra frontend skin that sits on top of SAP Analytics Cloud. It doesn't add extra analytical processing or capabilities per se, but it allows the existing content and information to be built up and presented in such a way that it supports the typical boardroom review process.

  Users can create a boardroom agenda that aligns with a typical executive review session, building up dashboards and analytical insight as appropriate. SAP Digital

Boardroom enhances this in two key ways: (1) it's designed to be operated using a big, touch-enabled screen; and (2) while it can present static, formulated content, it has complete flexibility in terms of navigating through the data and drilling down.

Because of these two aspects, users can interact with the information and navigate around in what can only be described as a *Minority Report* style, swiping around data and drilling in detail as needed.

Combined with the underlying capabilities of SAP Analytics Cloud, questions can be asked in real time by plotting forecasts or asking SAP Analytics Cloud to generate predictive models. In other words, questions from a boardroom-level meeting don't need to wait for the next session to get an answer because the attendees can use SAP Analytics Cloud and SAP Digital Boardroom to make that leap in real time, even going so far as updating plans and strategy into the wider business.

Figure 16.1 gives a flavor of the sort of content achievable with SAP Digital Boardroom on top of SAP Analytics Cloud, highlighting that geospatial data often features highly in modern analytics requirements.

Figure 16.1 Example SAP Digital Boardroom Dashboard Showing Information Augmented with Geo-Spatial Contextual Information

In this example, capabilities from ESRI are used to augment the SAP analytical information to help overlay location information into the data. This is a very common use case for SAP Analytics Cloud and analytics in general, where more and more the physical aspects of content and artifacts are useful to help represent the raw data associated with them.

SAP Analytics Hub

On paper, there appears quite a simple premise behind the SAP Analytics Hub software. It essentially answers the challenge we alluded to earlier of how to manage so many different analytics sources and solutions.

SAP Analytics Hub doesn't add content but instead acts as a single point of access to the disparate analytics content invariably spread across an organization's landscape. Crucially, this can apply to both SAP and non-SAP content.

With essential features such as single sign-on (SSO) and personalization of the curated content available, one of the real advantages of this software is that it ensures users both that they only need to access their analytics from one place and that they can explore and discover content from the wide range of published information in their organization's hub.

It's still very early in SAP Analytics Hub's maturity, but it's showing promise, and feedback from customers who have seen and experienced it is very positive. SAP delivers it as a subscription-based, software-as-a-service (SaaS) product, and because it's comparatively simple, it can be dropped into most existing analytical landscapes with minimal impact.

SAP BusinessObjects Business Intelligence Suite

We've covered a of a lot of ground in terms of SAP's BI solutions, and yet we haven't even begun to scratch the surface of its on-premise capabilities. Fortunately, SAP BusinessObjects BI suite has been around for some time, and, as a result, we can spend comparatively less time exploring and reviewing its capabilities because there is likely less "new" information in this space. Further, it can be quite a large and complex beast that warrants significantly more pages all to itself than we can afford in a book of this size and detail level. What is more important at this stage is understanding how all the latest on-premise and cloud products fit together in what is ultimately a hybrid model.

We'll take an overview of the key components of SAP's BI solution, but, more importantly, we'll try to paint a picture of what an overall BI landscape could look like with all the components mentioned in this chapter brought together.

As the name suggests, SAP BusinessObjects BI is a suite of software brought together to act as a fully featured BI platform rather than an individual element. As a very mature product offering overall (the BusinessObjects company was founded at the very start of the 1990s and subsequently acquired by SAP in 2007), there has been a significant amount of development and investment to polish the features and improve the user experience (UX).

What's Right for You?

Generally, SAP BusinessObjects BI has been the go-to solution for the more traditional element of BI, offering numerous reporting products to help deliver and distribute almost pixel-perfect content and output to users.

It provides the standardized, core reporting and analytics capabilities as part of a modern, bimodal BI strategy. SAP hasn't left it in just this space though, and before the cloud analytics solutions arrived, SAP put a lot of focus on the more modern capabilities within SAP BusinessObjects BI, specifically around the SAP Lumira product, which offers discovery and self-service capabilities to serve more agile requirements.

The approach with SAP BusinessObjects BI has been to ensure customers have access to literally everything they could need to manage and deliver their BI strategy and content, spanning right across both traditional and modern BI paradigms.

In short, SAP enable users to have both on-premise or cloud self-service tools, and the likely decision point will revolve purely around the customer's preference to cloud vs. on-premise, more so than features within the tools.

Various connectors and data acquisition methods within the suite ensure that this isn't just an SAP solution, and users can work with data from their entire enterprise, consuming information from SAP and non-SAP sources and then building up models and semantic information that enable the business users to discover and consume information.

In very simple terms, a consolidated landscape comprises a data layer, a modeling and building layer, and a visualization layer. However, those three simple layers can be quite complex with so many components in the mix.

Figure 16.2 shows a helicopter view of the many BI and analytics components in place working to complement each other by delivering a hybrid on-premise and cloud landscape, with coverage of both traditional and modern BI.

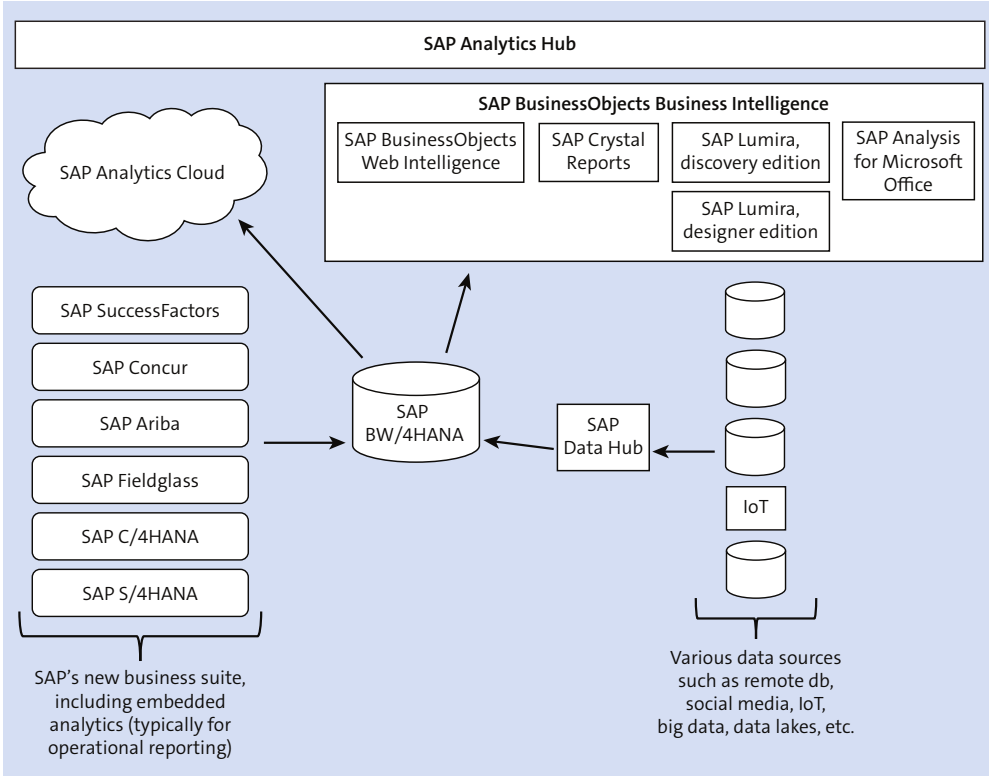

Figure 16.2 An Example (Simplified) Overall BI Landscape

The bottom right of the diagram shows the multiple data sources, such as remote DB, data lakes, structured/unstructured data, streaming IoT information, and so on. To provide the correct data preparation, this could be passed through SAP Data Hub to consolidate, merge, transform, and so on before it lands in the SAP BW/4HANA system.

The bottom-left of the screen shows the range of SAP's new business suite applications that would generally provide most operational information (and as we saw earlier, could also provide embedded analytics directly in the software). Again, this data could flow through SAP Data Hub or, in this simplified flow, straight into SAP BW/4HANA.

The entirety of the bottom half of the diagram represents the data acquisition and persistence functionality.

Moving upward, on the left, we have SAP Analytics Cloud, which, in this case, is pulling information via the SAP BW/4HANA system and making it available for planning, analytics, and to feed into the predictive engines. SAP Analytics Cloud could also connect directly to the business suite applications with a live connection to the underlying SAP HANA database, as well as pull information from remote data sources over on the right and persist locally. Typically, a landscape will make use of a mixture of these approaches.

The top-right quarter of the diagram shows the on-premise SAP BusinessObjects BI suite, again consuming information via SAP BW/4HANA (and again with the option of pulling some information direct via live connections). The components within the SAP BusinessObjects BI suite fall into three general buckets of capability:

- **Classic reporting**
  SAP BusinessObjects Web Intelligence and SAP Crystal Reports are used to deliver the pixel-perfect, static reporting per the traditional approach to BI, with the content being pushed out on a regular basis for subsequent consumption.
- **Analytical apps**
  SAP Lumira, designer edition (formerly SAP BusinessObjects Design Studio), is used to build enterprise-grade analytical apps, crossing over into the modern BI world. While SAP generally recommends that if you want to go full self-service, SAP Analytics Cloud is the way forward, some organizations won't be ready to go cloud for this capability and should use SAP Lumira, discovery edition. (Of course, there is nothing to stop cloud and on-premise solutions from coexisting.)
- **Office integration**
  To provide users with easy integration into Microsoft's productivity suite, SAP Analysis for Microsoft Office can be used to allow data to be pulled into spreadsheets and manipulated, generally where tactical insight is needed to support operational decisions and management. The content can be pushed straight into PowerPoint, and, crucially, there is generally minimal IT resource needed to support the business in what can be a self-sufficient activity.

Finally, with all this content being created and made available, over the top of the entire landscape is SAP Analytics Hub to enable easier access, curation, and consumption of the content (this could also include non-SAP content from other sources if that was in your landscape).

16.3 Enterprise Performance Management

To run an effective organization, planning, forecasting, and budgeting are essential elements of the overall management approach. For larger, more complex organizations, financials must be consolidated after the effect. Finally, organizations need to analyze or report on the results. These key areas make up what is collectively known as enterprise performance management (EPM).

Within the world of SAP, there are a few options for deploying and delivering EPM solutions in both on-premise and cloud options, as well as different software deployments depending on the specific use case in your business. SAP Digital Boardroom and SAP Analytics Cloud have already been covered in this chapter regarding some of their planning and analytical capabilities, so we'll focus on the two remaining products from SAP: SAP Business Planning and Consolidation (SAP BPC) and SAP Profitability and Performance Management.

16.3.1 SAP Business Planning and Consolidation

We've discussed SAP BPC in the context of finance in Chapter 9 and Chapter 10; now, we'll dive into SAP BPC from the analytical perspective. To review, SAP BPC is typically an on-premise solution that is used to deliver the full raft of capabilities to enable a business to do full end-to-end planning, forecasting, budgeting, and finally consolidation of their finances. It has been built by SAP to offer real-time integration into the SAP S/4HANA platform, which offers benefits throughout the EPM cycle. It also offers integration into SAP Analytics Cloud to support reporting and analytics in the wider landscape.

One of the core benefits of the SAP BPC solution is that it's an integrated platform for the full EPM cycle, so organizations can manage both the planning and consolidation activities in one place on a single set of data. Along with leading to efficiencies in terms of data and process, this also helps reinforce good practice that can ensure compliance with financial standards.

In line with many of SAP's analytics products, SAP BPC also supports integration with the Microsoft Office productivity suite, primarily through Excel, which has become the main window into SAP BPC for business users who can work with extensive data models in an environment that is familiar and is often heavily embedded in financial teams.

Customers looking to implement SAP BPC have two options at present: deploying SAP BPC for SAP BW/4HANA with SAP BW/4HANA as the backend system, or deploying SAP BPC for SAP S/4HANA with SAP S/4HANA as the backend system.

The main distinction is that SAP BPC for SAP BW/4HANA, as an add-on for the SAP ERP system, is generally used in a distributed landscape where there is more than SAP ERP feeding into the processing; conversely, SAP BPC for SAP S/4HANA generally uses SAP S/4HANA as the main source of information. A further consideration is that SAP BPC for SAP BW/4HANA can manage other planning processes, not just financial, while SAP BPC for SAP S/4HANA is mainly focused at planning for financials.

What's Right for You?

In summary, if you're deploying a fresh SAP S/4HANA system and want to manage your planning and consolidation activities purely based on your financial information in SAP S/4HANA, SAP BPC for SAP S/4HANA is probably the right choice.

If you need more flexibility, in terms of source systems to feed into the process, or indeed if you want to manage planning activities across more than just financials, SAP BPC for SAP BW/4HANA is likely the better option.

16.3.2 SAP Profitability and Performance Management

While SAP BPC is responsible for the core financial planning and budgeting process, SAP Profitability and Performance Management is more focused in scope and is used to analyze and model prospective profit within a business. Although a relatively niche product in SAP's overall lineup, it does offer a very useful set of features for those organizations that really need to understand the makeup of their profits in detail.

SAP Profitability and Performance Management is used to deep dive into profit margins and revenues and break this information down in various ways, such as by product, by customers, or by organization divisions within your company.

In terms of capabilities, SAP Profitability and Performance Management follows a similar pattern to other software solutions we've mentioned in this chapter: Data is acquired from source systems, typically the SAP ERP and data warehouses in a landscape. This data is then processed against models and algorithms designed to analyze profitability (in this case, the calculation engine is responsible). Finally, users can produce models and simulations that allow them to review profitability.

As well as enabling in-depth analysis of the historical profitability, SAP Profitability and Performance Management also uses some of the predictive capabilities in the underlying SAP HANA engine to determine future outcomes, so users can model how changes to their product lines or customer segmentation might impact their profitability.

As mentioned, this product runs on the SAP HANA platform and can be deployed either on-premise or into an SAP HANA instance in the cloud. As it follows the SAP Fiori design approach, the applications are consistent with other SAP applications, and the enhanced user interface (UI) components available as part of the SAPUI5 framework that sits below SAP Fiori offer a very visual interface into the software.

16.4 Predictive Analytics

Many data- or information-based tools have long had a what-if scenario or similar capability designed to assist users in forecasting or predicting what might happen in the future based on historic and/or current information. Often this manifested as rudimentary trend lines that based their output on just the data at hand, without considering wider context or other influencing factors. Certainly, the algorithms available offered limited options in terms of modeling outcomes.

As the movement around data science has grown, so has the range of tools available. Specifically, algorithms and calculations that would previously have been confined to more scientific teams have crept more and more in to the mainstream. Organizations have wanted to use these statistical and analytical models in conjunction with their existing business data.

SAP wasn't slow to respond, providing a number of products with predictive capabilities; however, the uptake to date has been somewhat slower than anticipated. Generally, this may be more based on the lack of true business opportunity, often due to older landscape constraints, rather than a lack of capability in the predictive services available.

As SAP now pushes toward the intelligent enterprise, a core part of that will be continued growth of predictive capabilities, typically embedded as part of the wider business suite applications, such as SAP C/4HANA or SAP S/4HANA. Dropping down a level, we'll quickly explore the key offerings from SAP that currently enable predictive and related data science activities: SAP Predictive Analytics and the Predictive Analytics Library (PAL).

16.4.1 Predictive Analytics Library

With the PAL content on SAP HANA, SAP has packaged up nearly 100 different data science algorithms. While these are simply interpretations of widely available algorithms, they have been specifically built to take advantage of SAP HANA's engines and processing power. Importantly, because they run inside SAP HANA, right next to the data, PAL can take advantage of the processing power available.

These components aren't designed to be used in isolation; rather, they are more tools in the toolkit that users can build into their wider processes and solutions. Moving forward, as more functionality is released in business apps to move toward the intelligent enterprise, SAP will be using the predictive engines more and more across some of the core, standard business functions, leading to more automation and better use of data in those areas.

16.4.2 SAP Predictive Analytics

While the PAL components can be used by data scientists and developers alike, they are a comparatively low-level offering, providing raw building blocks for users to consume in their own solutions and data processes.

Often, the bigger challenge for organizations is to define, build, and train the larger models used in predictive processing in an efficient and timely manner. SAP Predictive Analytics may be the answer to this, in the rough form of an automated factory for creating predictive models that can be reused across the enterprise. Figure 16.3 shows the Predictive Factory screen.

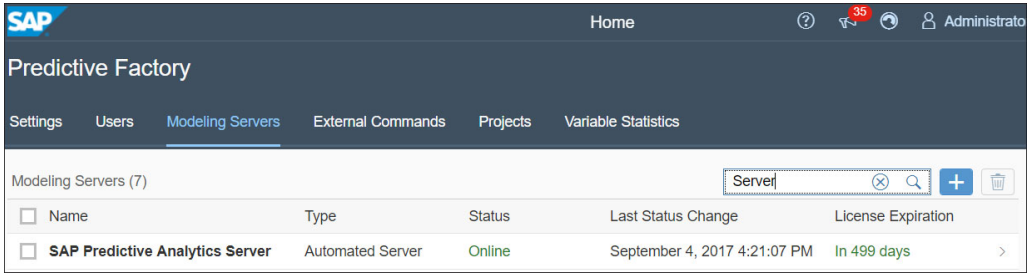

Figure 16.3 Predictive Factory

SAP Predictive Analytics allows the user to feed in a raft of data and related questions and allow the engine to automate the development of suitable predictive models.

They are generated and tested, providing scoring for characteristics, such as confidence, and the completed models can then be published and used in wider applications.

While this may sound like PAL, consider that SAP Predictive Analytics takes the core components within PAL and builds them up into an almost predictive orchestration layer. It also adds more guided and automated wrappers around the core predictive processing, making it more accessible to analytics experts rather than pure application or database developers.

Further, because the software has automation capabilities, SAP Predictive Analytics can be configured to rerun models at regular intervals, for instance, to take in the latest batch of data and information and recalculate outputs or retrain the models to ensure they are still delivering the right results.

SAP Predictive Analytics is an on-premise only solution at present, and indeed is likely to be slowly superseded by the predictive capabilities in SAP Analytics Cloud. For now, however, it's the go-to solution for customers wanting to extend their on-premise BI capabilities with some predictive processing.

16.5 The Road Ahead

Analytics, especially within the world of SAP, is changing dramatically at a pace not seen before. One of the key elements of this is SAP's continued push for a cloud-first model.

While the cloud still isn't everyone's deployment model of choice, SAP isn't slowing down in its ambition to move as much of its suite as possible to a cloud model.

SAP Analytics Cloud is one of the more recent outcomes of this strategy, and after beginning life as a comparatively basic capability, the cloud's regular update cycles (there are generally two releases for SAP Analytics Cloud each month) means that its features, capabilities, and functions are being improved, expanded, and refined constantly.

In the short- to mid-term, you should expect to see the features within this product continue to grow and be refined; however, in the longer term, the real difference will be how SAP manages the many current different analytics and reporting solutions.

As part of SAP's push for the intelligent enterprise, and ultimately the intelligent suite that enables it, SAP will likely focus most of its efforts on the strategic pillars to

deliver that. From an analytics perspective, all current information and road maps suggest this will be SAP Analytics Cloud.

In very simple terms, SAP Analytics Cloud will become the analytics-as-a-service (AaaS) capability within SAP's arsenal, straddling across the wide gamut of the SAP Business Suite applications as well as custom platforms and even non-SAP sources.

Further, the SAP Digital Boardroom extensions that currently sit on top of SAP Analytics Cloud will also mature and likely find differing use cases. Already, in its short life, it has evolved from the position of a pure C-level boardroom analysis tool into something much bigger, enabling a complete analysis path from the boardroom level down through an organization and on into operational territory.

It's difficult to guess how SAP will continue to position SAP Analytics Cloud, SAP Digital Boardroom, and SAP Analytics Hub alongside each other over time, as there is some crossover in their capabilities and use cases. However, it wouldn't be a massive surprise if SAP created something like an "Analytics Management Suite" that contained SAP Analytics Cloud, SAP Digital Boardroom, and SAP Analytics Hub with tighter integration and less crossover of capabilities.

Further, as we touched on in Chapter 14, it seems that the real ambition of SAP in this space is to rationalize down, and whether it remains as SAP Analytics Cloud and SAP Digital Boardroom, or something else, there is a logical argument that says all of these products will simply converge into one solution, rather than a package of disparate ones. We may even see a reprisal of the BusinessObjects Cloud name for such a platform.

As an aside, and looking back at SAP's EPM capabilities, specifically around planning, SAP is just starting to push real planning capabilities within SAP Analytics Cloud. While the capabilities aren't currently at the level of full SAP BPC, again the logical longer-term ambition for SAP must be to consolidate onto a single strategic platform, which is likely to have a cloud flavor.

From a more esoteric angle, the role and delivery method of analytics is likely to change with lots of influence from the broader UX world; we've already touched on conversational UIs (CUIs) in Chapter 15, and SAP is working to embed this capability into its analytics tooling. SAP Digital Boardroom has already changed a lot of thinking about the general UX to analytics, so expect to see continued refinements in the interactive approach.

Capabilities such as machine learning and automation will also continue to have a bigger responsibility. Think back to the exploration of traditional BI earlier in this

chapter. One of the key features is that static content is generated regularly, irrespective of whether it's actually consumed. Automation and machine learning could be deployed to only generate analytics as needed, almost acting as a bridge between static content and self-service, with the overall landscape spotting potential issues or opportunities and pushing the relevant information to the right recipient at the right time.

More automation possibilities will see less of a reactive approach to analytics generally. In addition, instead of many users being bombarded with a constant stream of information, the broad SAP landscape will try to deal with general operational anomalies autonomously, with only real exceptions being promoted to humans for intervention.

If we go back to basics and consider why analytics is important—to support decision-making and strategic direction—this just-in-time, focused approach to delivering the right answers is likely to be a very effective approach to analytics, especially as the world of data and information continues to grow beyond users' abilities to consume and react.

In the next chapter, we'll move on to our final data topic: enterprise information management (EIM), where we'll get into some of the real enablers for maximizing analytics, BI, and database solutions by exploring the management of data in its purest form.

Chapter 17
Enterprise Information Management

This chapter looks at one of the key components of any enterprise—data. Here we cover the governance of that data, how to identify and resolve data quality issues, and how to migrate your data into your next-generation SAP solution.

Enterprise information management (EIM) comes down to a single element—data—from its creation and maintenance, to understanding its quality, remedying its issues, or even migrating it from legacy solutions to new generation systems. Unfortunately, data is often seen as an irritating hurdle to getting the important job of running the business done. This is wrong — very wrong in fact — as complete, trustworthy, and relevant data is the lifeblood of business processes, accurate reporting, and the very initiatives that make running your business possible in the first place.

To illustrate this point, Figure 17.1 outlines the impact of "bad data", in this case, vendor data, on business effectiveness. Bad data has impacts ranging from simple inefficiencies and rework to more substantive impacts on the bottom line in the form of impacts to business relationships and the risk of fraud.

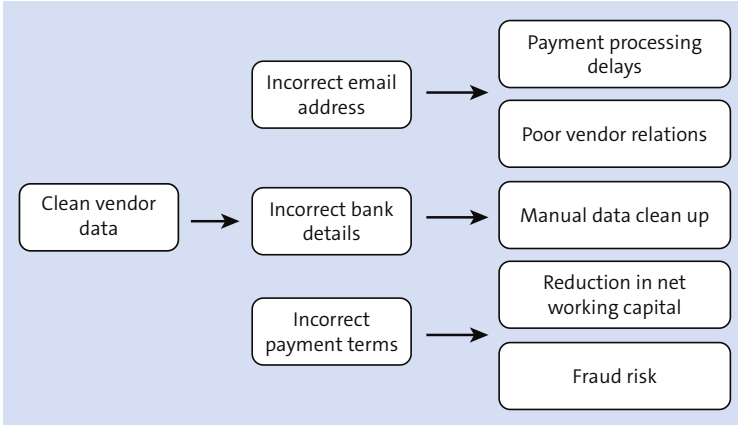

Figure 17.1 Potential Impacts of "Bad" Vendor Data

There has been a recent upturn in data's street cred with the rise of big data, the creation of chief data officers, and articles describing the "data goldmine" and promising that "data is the fuel of the future." This has in part been driven by the adoption of cloud services and the seemingly continual business imperative to find efficiencies—in short, businesses can no longer ignore their data.

This chapter looks to outline the importance of both EIM and data, while providing a look at SAP's approach to EIM. After a look at our business case, the chapter describes the need for a data strategy and gives a view on what such a strategy should cover. We then look at the key activities around data: its creation and maintenance through data governance, the identification and correction of data issues through data quality and data remediation, and how to move data into your next-generation SAP solutions through data migration. In each case, we'll outline the relevant SAP tools and products that can enable these activities (SAP Master Data Governance, SAP Information Steward, and SAP Data Services, in particular) before closing with a look at the road ahead for SAP in this space.

17.1 Business Case

For years Bault Robotical "managed" data without actually managing their data. While Bault Robotical's transition to its previous ERP system had necessitated a data migration exercise, it had largely replicated existing data issues. Subsequent efforts to control data in a meaningful manner were minimal, and accountability fell squarely in the gap between IT and the line of business (LoB) functions with neither claiming overall responsibility. Over time, the organization had developed and perpetuated what would best be described as "a coping mechanism" wherein the daily occurrences of data quality issues were dealt with as a background activity. Correcting data in an ad hoc manner amounted to a necessary evil; the equivalent of filling in employee time sheets and expenses forms, but with far wider repercussions on the organization when data wasn't fit for its purpose.

Business issues caused by poor quality data were plentiful. At least two plant shutdowns (thankfully temporary) were attributed to poor quality material master data. Supplier relations suffered with remittance being delayed on a regular basis due to incorrect bank details and contact data. Inferior customer data, as basic as invalid postal addresses, led to issues but the extent was obscured by the fact that Bault Robotical operated a business-to-business (B2B) model, and most information was kept in the heads and email accounts of the sales team, an untenable position given

the future vision to develop a business-to-consumer (B2C) business as well. Even regulatory reporting processes were routinely hampered and delayed by a lack of consistently defined financial data.

While poor data routinely created issues, the real problem for Bault Robotical was that these issues weren't of a significant enough level to cause long-lasting damage because the issues would invariably be resolved through back-door mechanisms and personal networks.

Having multiple organizational silos within Bault Robotical amplified the void of governance, and the lack of a central function for enterprise-wide data management or a common overall approach meant individual teams survived by relying on a network of informal contacts to amend data as needed. A problem in manufacturing led to a phone call to a friend in the operations team, which led to a quick change of data in the SAP ERP system, and hey presto, the issue was gone—often the same day! However, the magnitude of the effort remained unnoticed rather than purposefully hidden, and this reactive approach propagated throughout the business to the extent that it became the standardized norm. A vicious cycle of "data neglect" formed, and nobody at a senior level with Bault Robotical felt the need to tackle this head on as the hidden cost was, well, hidden—if not well and truly buried.

So, what changed? As the company started on its transformation journey, the Bault Robotical leadership team saw a number of initiatives stalling and being delayed due to poor data quality, and the previously hidden problem started bubbling to the surface. Given the scale of investment going into transforming the business, the Bault Robotical leadership team was not about to risk the same outcomes. However, lacking a clear understanding of the issues or even a starting point, the team first decided to carry out a data strategy exercise to create a way forward.

The strategy focused on understanding the drivers pushing for change by identifying key data pain points, such as the multitude of business processes and manufacturing issues caused by bad material master data. This pointed to a clear need for governance over business-critical data objects, a mechanism to assess data quality and remedy issues on an ongoing basis, and finally a more rigorous approach to data migration to prevent bad data coming into the new systems in the first place. With these objectives in place, Bault Robotical was in a position to move forward by eradicating poor quality data and establishing appropriate governance over its data through the use of SAP tools such as SAP Master Data Governance, SAP Information Steward, and SAP Data Services.

17.2 Data Strategy

A data strategy is an overarching vision for the data-related goals of your business. Creating such a strategy is crucial as today's businesses run on data—a lot of data. So, it's important to lay out some guiding principles as to how that data is managed and to identify the key data objects and initiatives that will deliver the most value to your business.

In a fast-moving world, rather than professing to know how business priorities will change over time and thus predict the potential impact of the business on data and of the data on the business, most strategies come with a medium-term time frame of three to five years in mind.

A data strategy is only worth formulating if it's supported by the appropriate level of sponsorship; that is, it needs to be approved by senior stakeholders and will undoubtedly need to include budgetary support. The strategy should document your organization's objectives with respect to data and inform a wider view of how data fits into the business objectives. It needs to be outwardly visible to the wider organization and should be seen as a "living" document, that is, a document which needs to adapt as the business changes. It defines the action plan for data and outlines the key building blocks sustain the plan.

Figure 17.2 shows the main building blocks of a data strategy, which is based on providing business drivers as an input to the strategy and results in the output of potential data-enabled outcomes.

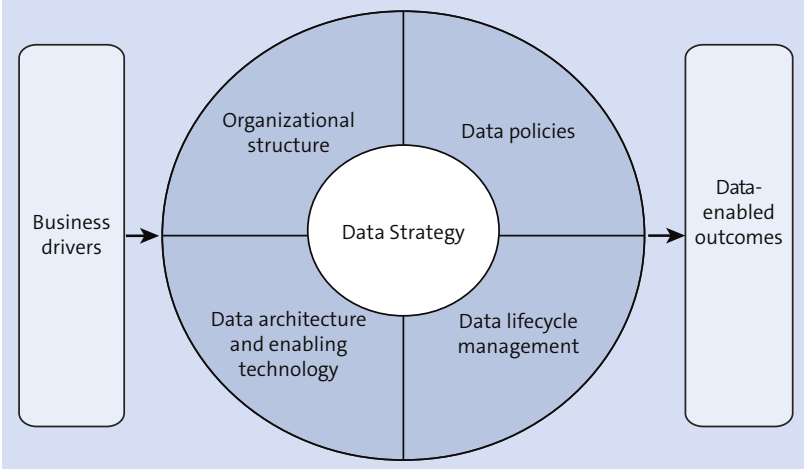

Figure 17.2 A Holistic View of a Data Strategy

Let's take a closer look at the building blocks outlined in Figure 17.2:

- **Organizational structure (data ownership)**
  Addresses the gray area of who is accountable for the quality of data within your organization when there is a gap between expectations of what IT supports and what LoB functions, such as procurement or sales, actually manage. Hence the need for clear definitions of ownership and accountability provided through Responsible, Accountable, Consulted, Informed (RACI) matrices per data domain. This may require the creation of a suitable organizational structure or the formation of a data center of excellence.
- **Data policies**
  Made up of a number of strands, including the development of a set of document data standards that involve the formulation of a Data Dictionary for each key data object and the development of data quality key performance indicators (KPIs).

  A Data Dictionary is exactly what it sounds like—a documented view of the individual data elements making up a data object. It contains detailed information per element, such as its meaning from a business and technical perspective, format, usage, and relationship to other data elements. Given the size of the SAP S/4HANA data model, the development of the Data Dictionary per data object is a considerable exercise requiring a combination of technical knowledge and business awareness.

  After the Data Dictionaries are in place, the concept of data quality KPIs are partially enabled. The KPIs can be defined at the data object level (e.g., material master) but also at the data element level (e.g., uniqueness of material master ID). These are intrinsically linked to the definitions captured in the Data Dictionary. The dimensions against which KPIs are defined need careful consideration as these lead to the quantification of the quality of the data itself.
- **Data lifecycle management**
  The definition of mater data is created and maintained throughout its lifecycle (creation/ingestion) until its death (deletion/archiving). This also covers detailing which systems and solutions in your landscape share common data objects, for example, which solutions capture and consume customer data and would therefore need to be part of the "lifecycle" of customer data. As well as defining what the data lifecycle should look like, this block of the strategy identifies data objects that require greater governance in their lifecycle than others due to regulatory requirements or the potential impact of ungoverned poor data quality on the consuming business processes.

- **Data architecture**
  Outlining the technical platform required to deliver on your organization's data ambitions. This would typically look at the tools used to govern your data (Section 17.3), assess its quality and remedy data issues (Section 17.4), deal with how data will be integrated across systems (see Chapter 19), and define the tools to be used to migrate data into new solutions being added to the landscape (Section 17.5). Finally, this building block would lead to the creation of a prioritized road map for the deployment of these data solutions. This would focus on the business goals delivered by the various technical solutions, with the road map focused on eradicating pain points and making as significant an impact to the business as possible.

17.3 Data Governance

Applying governance to the creation and maintenance of your master data can bring significant benefits to your business by increasing adherence to your data policies, reducing risk of bad data impacting business processes, preventing fraudulent behavior, and reducing your reliance on manual data entry or copying. So why wouldn't you apply the maximum level of governance available to all your master data objects?

Putting aside the costs around implementation, infrastructure, maintenance, and licensing, the answer is that you simply don't need to! If you've created a data strategy, as outlined in Section 17.2, then you should have identified some key pain points around your master data and potentially some risks around the way in which key objects are managed. This could include a proliferation of cost centers resulting in reporting and cost assignment problems, or duplicate vendor records causing issues with misaligned data and an inability to accurately calculate gross spend.

Then there is the process cost in overgoverning data, that is, the time spent running through governance processes for data objects where the returned business value on doing so is minimal as well as potential delays in executing business processes while key data records are stuck in data governance. What is needed is an effective balance between the level of governance, the gained value in governing the object, the volume of change in the object, and the risk in not governing an object (particularly from a regulatory or statutory perspective).

After we've identified the need for data governance, how do we know it's being effective? An effective data governance solution delivers control over the following key areas:

- **Data**
  Effective data governance brings control over your data by defining an appropriate data model, including which parts of the data model are actually relevant to your business. Anyone who has spent time with the SAP material data model will know that the entire model is rarely used, so your data governance should reflect only the data elements your business requires. It should also ensure that business rules around your data are consistently (and automatically) applied, that your data is validated at the point of entry, and that it's enriched with additional information, again based on consistent and automated business rules. Finally, the data should be integrated into your solution and syndicated across the enterprise to ensure consistency.
- **Process**
  This is control over the process of managing master data, in terms of standardizing the process followed to ensure adherence to the process, visibility of that process, and the notification and listing of actions within that process so that users know that they need to enrich or approve data.
- **Usability**
  The third element covers usability; a difficult to use data governance solution will be rendered obsolete because users avoid it! This requires the solution to have a relevant user interface (UI), which reacts to the context of the business user (e.g., only showing fields that are relevant to the user in question), and to provide auto population and filtered lists to aid the user. After all, there is no point in a data governance solution that enables the population of incorrect values.
- **Compliance**
  The final element is compliance, which is enabled by ensuring that data can only be managed within your governance process. Segregating the request of data changes from their activation in the systems with accompanying service level agreements (SLAs) ensures a reliable service for the business that meets its needs. It should also be auditable so that users are accountable for the changes they initiate, and any holdups in the process can be identified and rectified.

To achieve effective data governance, SAP offers SAP Master Data Governance (SAP MDG) in two flavors: SAP MDG (running on SAP ERP 6.0, either using any DB or SAP HANA) and SAP MDG on SAP S/4HANA. For the purposes of the book, we'll focus on the latter (which we'll simply describe as SAP MDG) because although all of these options are valid, SAP MDG on SAP S/4HANA will be the focus of innovation, so we expect to see a greater deviation in the product features available going forward.

Out with the Old

Before SAP MDG, there was SAP Master Data Management (SAP MDM), which was a third-party product bought by SAP and turned into their first master data solution. SAP MDM didn't run on a traditional ABAP stack; instead, it ran on its own stand-alone platform. Although SAP MDM did come with a variety of standard content for key data objects (e.g., customer and material), it has been declared as end of life (EOL) by SAP, and as such has no ongoing road map or investment.

SAP MDG as a product is squarely aimed at delivering effective data governance. As such, it brings a number of key capabilities to the table:

- Close integration with SAP S/4HANA
- Standard content covering multiple functional areas
- Workflows and role-based access to enable governance processes and segregation of duties
- User-friendly UI, with both Web Dynpro and SAP Fiori supported (SAP Fiori from SAP MDG 8.0)
- Support of automated and reusable business rules
- Notifications and worklist functionality
- Extendable framework, enabling customization of standard objects and custom objects
- SAP HANA fuzzy search, enabling advanced search and de-duplication
- Fast consolidation of master data records based on SAP HANA information management services for standardization and matching
- Management of SLA compliance through SAP HANA analytics

Alongside the last three capabilities in the list, SAP has further used the capabilities of SAP HANA to enable better mass data processing and used SAP MDG analytics to offer insights beyond simple SLA reporting.

The provision of standard content for SAP MDG means that you can quickly deploy SAP MDG to govern key objects within SAP S/4HANA based on the standard data model, validations, and simple governance processes. The content available covers a wide array, including order-to-cash, procure-to-pay, design-to-order, service and maintain, and acquire-to-retire. Key data objects within these processes are delivered

as part of the standard content, such as materials, customers, vendors, and cost centers.

SAP MDG operates in two main modes:

- **Central governance**
  The central governance mode means that the processes around the creation and maintenance of governed data are run centrally, with the outcome being one point of maintenance and a central view of the truth which feeds systems that require the governed data object. An example of this is the management of cost center data via SAP MDG, with the data then consumed by SAP S/4HANA, SAP SuccessFactors, and SAP Concur.
- **Master data consolidation**
  The second mode, which has been enabled by running SAP MDG on SAP HANA, is for the consolidation of master data either ahead of central governance or as part of continuous consolidation. This can be used where systems in your landscape aren't centrally governed either because they are coming into your landscape via mergers and acquisitions or because ownership of systems is decentralized (both within your organization or in systems run by your partners). You can also run SAP MDG in a hybrid approach with data being centrally governed in some instances and continuous consolidation keeping your data clean in others.

Consolidation has been brought into SAP MDG by the use of SAP HANA as the functionality to quickly search and match data. As such, the standard content available is a subset of the content available for the central governance mode, with support for business partner (customer and vendor), material, and custom object consolidation. Consolidation can be achieved in two ways:

- **Consolidation of source records**
  New records arrive as an import into SAP MDG before the source data is checked for quality, enriched, and standardized and before being matched against existing records. High-quality matches are consolidated into a "best record" that can then be validated and finally released as the active record. This scenario could be used to consolidate data from an acquired company's systems into your central instance of SAP S/4HANA or where a remote system creates new master data records that need to be continually brought into the core.
- **Consolidation of active records**
  Duplicate checks can be carried out against active master data records periodically, first by selecting the objects you want to check and then by running the same

matching rules and calculations used to find a best record for new records. After a best record is identified, it can be validated and activated. This can be used to augment central governance of an object or for objects with light touch governance (limited rights to create and maintain) to ensure that the data remains at a good standard without a fully managed governance process.

The central governance mode for SAP MDG consists of various processes to govern the creation and modification of data. At its simplest form, this will consist of a request made to either create or change a master data record; once submitted, an approver will review the request and either approve (activate the data record in the system) or reject the request.

To give you a better understanding of what this process would look like, we've included two screenshots from a cost center scenario that follows the same process shown in Figure 17.3. In this example, a cost center is being edited by the business user, and SAP MDG highlights the fields that have been modified. Figure 17.4 then shows the approver view.

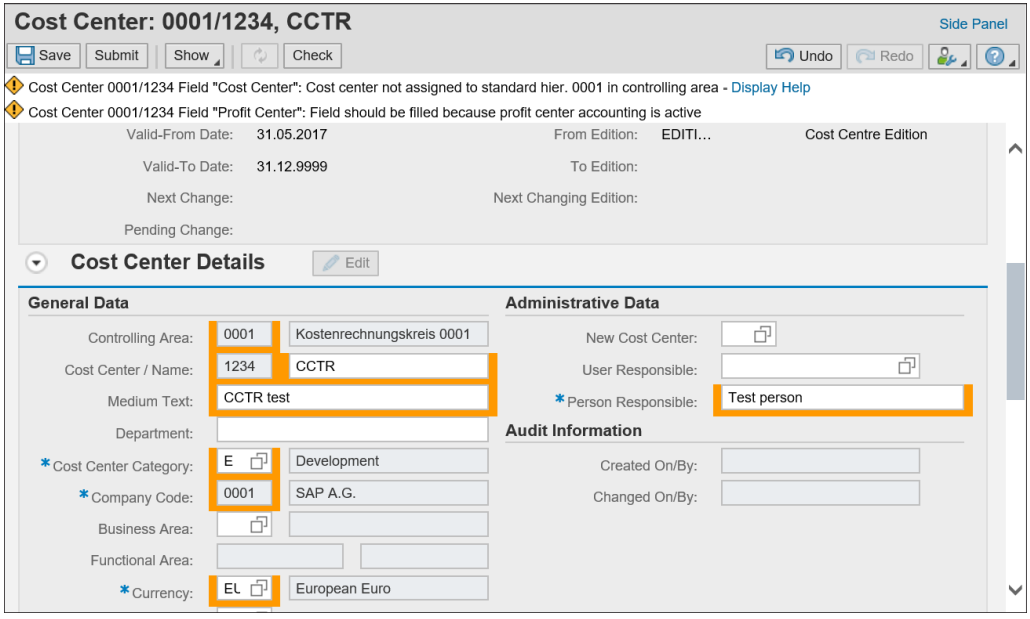

Figure 17.3 View of an SAP MDG Request to Change a Cost Center

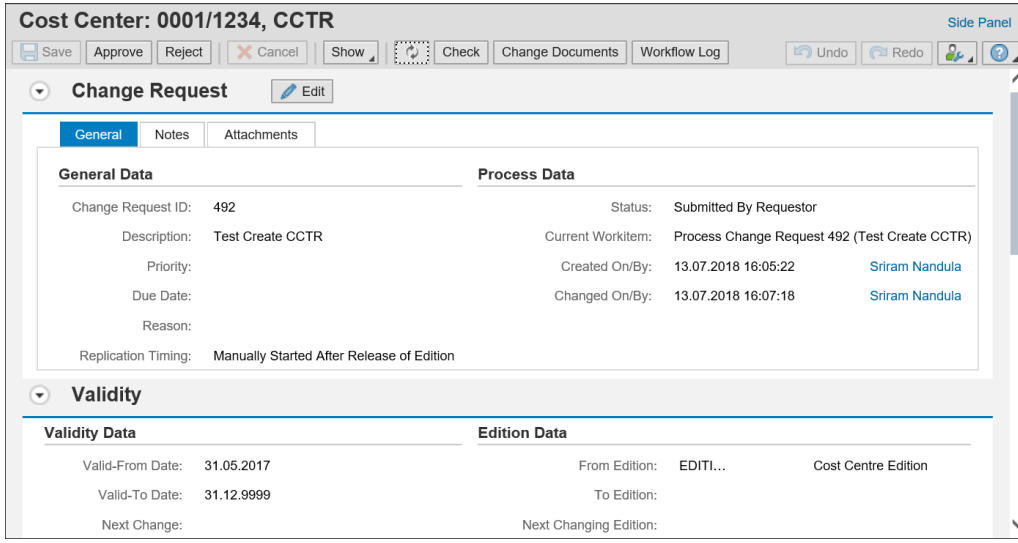

Figure 17.4 Approver View of an SAP MDG Change Request for a Cost Center

As shown here, SAP MDG provides the ability to effectively govern your data, both through central governance to keep your data clean and through the use of continuous consolidation to get your data clean. This both reduces the risk of process inefficiency and ensures that future initiatives are built on a solid foundation of good, clean data.

17.4 Data Quality and Remediation

We've already taken a look at the impacts of poor data quality (refer to Figure 17.1), starting with simple process inefficiency, moving on to creating poor vendor relations, and the possibilities of fraudulent behavior. In this section, we'll return to this theme and look at why the quality of your data is so important and what tools SAP offers to discover, monitor, and cleanse poor data within your systems.

In Figure 17.5, you can see the types of impacts poor data quality can have on your organization, and the scale of the impact can include highly significant impacts, such as a reduction in decision-making capability due to data unreliability (as data powers our ability to accurately report on and gain insights into business performance) and the derailment of strategic initiatives. The instances of these more serious impacts

have been growing along with the challenges facing businesses in this area, such as the following:

- Increases in the volume, velocity, and variety of data that matters to businesses
- Impact of digital transformation and cloud services in creating a more distributed landscape with key functionality spread across applications, resulting in poor data having more entry points and a wider impact
- Business demand to be more agile, provide real-time insights, and shorter time-to-value cycles

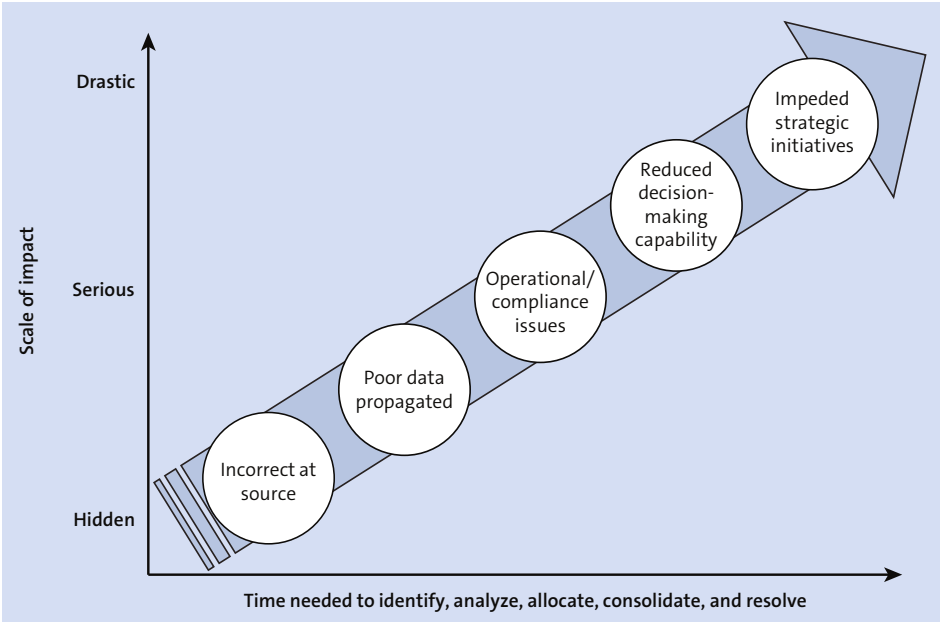

Figure 17.5 Graph Showing the Various Impacts of Poor Data Quality

To meet these challenges, your data has to be up to scratch, and, more importantly, your approach to data quality has to be repeatable, automated, and extendable to react to changing business demands quickly.

An effective data quality approach operates in a cycle, whereby you measure, improve, apply governance, and monitor your data, as illustrated in Figure 17.6.

We've already looked at the governance of data in Section 17.3, so next we'll look at how you can discover and measure your data quality, followed by a look at how data quality can be monitored and improved in Section 17.4.2.

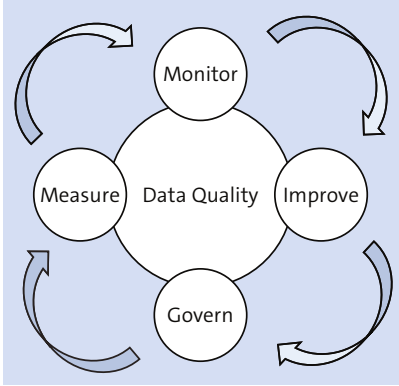

Figure 17.6 The Data Quality Cycle

17.4.1 Discover and Measure

To properly profile your master data and identify potential quality issues, you need some tools to help you out. SAP provides a number of these tools within SAP Information Steward, which builds on SAP Data Services, and SAP HANA smart data quality. Here we'll look at the options in turn.

SAP Information Steward

SAP Information Steward is aimed at business users, in particular, those tasked with managing data quality in their organizations. It allows users to quickly start to understand and profile their data (see Table 17.1 for details of profiling options in SAP Information Steward) so that they can create rulesets to both monitor and remediate data going forward. Within the discover and measure phases of the cycle, users work within SAP Information Steward to assess the quality of their data by drilling down into its characteristics and creating rules against which data quality can be assessed.

SAP Information Steward achieves this by enabling users to browse metadata from source systems and drill into data records. Because SAP Information Steward is partially built on SAP Data Services, it can make use of the SAP Data Services connectivity options, making SAP Information Steward a good tool for the investigation of your entire landscape, including third-party applications.

Profiling Type	Description
Simple	Attributes such as the maximum and minimum value of a field, or how complete it is in terms of number of instances that the field is populated.
Median and distribution	Calculates the median value or string length, along with the distribution of values or patterns in the distribution.
Word distribution	Helps identify naming patterns within fields and whether those patterns are consistent or not.
Address profiling	View of whether address data is accurate, potentially correctable via an address cleanse transform or invalid.
Dependency	Identifies the relationship between one column, and one or more dependent columns. This can be useful if a one-to-one relationship between the values in the first column and its dependent column(s) should exist.
Redundancy	Reveals any overlap of data between two data sets.
Uniqueness	Shows whether or not the contents of a particular column, or set of columns, are unique. Where the contents aren't unique, the profiling splits out the count and percentage of rows by whether or not they are unique.
Content type	SAP Information Steward makes a guess at the suggested meaning of the data in the column. Having identified the content type, SAP Information Steward can then recommend data cleansing routines.

Table 17.1 Types of Data Profiling Supported by SAP Information Steward

SAP HANA Smart Data Quality

In Chapter 14, we looked at the various native features of the SAP HANA platform, and SAP HANA smart data quality is another set of services delivered as part of that platform. In this case, the focus of SAP HANA smart data quality has been to clean data for use within analytics on SAP HANA platforms; however, SAP HANA smart data quality has a broader use as it comes with its own profiling capability around the following:

- **Semantic profiling**
  Identifies the data type.

- **Distribution profiling**
  Covers field, word, and pattern profiling.
- **Metadata profiling**
  Looks at column names, data types, and field lengths to determine the content.

As opposed to SAP Information Steward, SAP HANA smart data quality doesn't have the same focus on engaging business users or a comparable ability to work across non-SAP HANA-centric environments. It does, however, have other benefits related to the monitoring and improvement of data that we'll cover in the next section.

17.4.2 Monitor and Improve

Now that you understand your data, you can start to look at how you can improve and continually monitor it on an ongoing basis. SAP again provides a number of options with SAP Information Steward in combination with SAP Data Services and with SAP HANA smart data quality alongside SAP HANA smart data integration offering differing approaches to the same problem.

SAP Information Steward and SAP Data Services

Earlier we looked at how you can use SAP Information Steward to profile and identify data quality issues and how you can then define rulesets that help identify good and bad data. After you have those rulesets, you can create scorecards within SAP Information Steward that help you not only rate your data but also track trends and define a cost against your bad data. Scorecards could cover customer, material, and vendor data, for example. While this will give you the ability to continually monitor your data quality, the question is how can you remedy problems your monitoring identifies.

Within SAP Information Steward, you can generate cleansing rules that can be executed by the user to cleanse your data, but you can also leverage the power of SAP Data Services to generate cleansing jobs that can crunch through your data and cleanse it. Job scheduling within SAP Data Services allows you to set up regular automated data cleansing jobs to keep your data in order. Possible data cleansing transforms that can be automated include the following:

- **Address cleanse**
  Using a standard address cleansing package from SAP, this transform will match address data in your system to a global set of address records and then correct your record with missing information or by replacing inaccurate data.

- **Data cleanse**
  This transform either takes the form of a standard cleansing transform for names (whether person or company names) or a custom transform based on the cleansing rules generated in SAP Information Steward.
- **Match**
  This transform identifies matching records for the deduplication of your data, for example, the removal of duplicate customer records.
- **Geocoding**
  This transform can interpret spatial data or enrich your existing data with spatial data, for example, adding latitude and longitude data to an address.

SAP HANA Smart Data Quality and SAP HANA Smart Data Integration

SAP HANA smart data quality contains a similar array of data quality transforms (including cleanse, match, and geocode) and can be combined with SAP HANA smart data integration in a similar way to SAP Information Steward and SAP Data Services. SAP HANA smart data integration can use logic created in SAP HANA smart data quality to improve the quality of your data. However, what the smart data tools offer as a point of difference is the ability to embed this functionality within your application. So, by checking data at the point of entry using the SAP HANA smart data quality transforms, you adopt a different approach to looking at issues retrospectively; instead, you prevent data quality issues from occurring in the first place. A good example of this is with some of the features seen in SAP MDG on SAP S/4HANA that make use of the data quality services within SAP HANA smart data quality.

Another option is to make use of SAP Data Quality Management microservices for location data, which is a new cloud-based set of services that provide address cleansing and validation and geolocation enrichment combined with built-in integration to SAP applications (e.g., SAP Business Suite, SAP S/4HANA, and SAP Cloud for Customer).

What's Right for You?

It's reasonable to wonder what direction you should go with the multitude of options available. SAP is investing heavily in the SAP HANA platform, so SAP HANA smart data quality and SAP HANA smart data integration are likely to evolve rapidly, and they are also available within SAP Cloud Platform as part of an SAP HANA instance. Having said that, both SAP Data Services and SAP Information Steward

have been the subject of significant customer investment, so these aren't going anywhere soon. Fundamentally, you need to understand your data requirements, and if SAP HANA smart data quality and SAP HANA smart data integration can cover those today, then they may well be the long-term bet. However, if they don't, and the road map is too far out for your organization, then SAP Data Services and SAP Information Steward have the pedigree and maturity to deliver what you need, particularly in heterogeneous landscapes.

17.5 Data Migration

Data migration is one of the most thankless tasks within large-scale transformation programs—get it right and no one notices, but get it wrong and everyone knows about it! In essence, it sounds simple, take data from your existing systems and move it to your new systems, but, in reality, it's normally not so straightforward. The main challenge faced during data migrations is the state of the data within the existing system: Has it been properly governed? Do you keep on top of the quality of the data? The inevitable answer is "not really," and so the challenge begins.

However, we really see data migration as an opportunity or, actually, a series of opportunities:

- **Minimization and housekeeping**
  Remove obsolete and unwanted data, which reduces your storage footprint and increases compliance. Do you really need 10 years of sales order history in SAP S/4HANA?
- **Cleansing**
  Ensure your data quality is fit-for-purpose and ensure your data integrity. A migration exercise is an ideal opportunity to clean up your data.
- **Consolidation and data salvage**
  By creating golden records from duplicate records in your existing landscape and merging transactional histories, your new applications will have a single view of the truth.
- **Enrichment**
  Take existing data records and add further information and data attributes to increase the usefulness and value of the data. For example, add spatial data to asset records.

- **Model optimization**
  Getting the detail right, ensure that you only have the necessary fields in your model and that the data types and lengths are accurate.
- **Address pain points**
  This is one of the key opportunities because it's very difficult to change after the data is in the new systems. If you're hampered by inconsistent numbering of data records, for example, take the opportunity to convert to a correct sequence and format.

In this section, we'll first discuss the main data migration process, followed by the major SAP solutions that facilitate it.

17.5.1 Data Migration Phases

Data migration projects go through the following phases:

1. Plan
2. Design
3. Execute
4. Reconcile
5. Sign-off

Let's start with the plan phase. Here it's critical to get a good understanding of the scope of data to be moved across. This can cover different types of data (transactional, master, and reference), so one of the first tasks of a data migration team is to work out what data and how much of it needs to be carried across. SAP Information Steward (discussed in Section 17.4) can help in the initial data investigations needed to establish the scope, volume, and quality of data needed to be brought across to your new solutions. The plan phase will also lay out dependencies between the data migration and the need for data in various phases of the wider project (e.g., testing).

After the planning and profiling of the data to be migrated has been completed, we move on to the design phase in which we need to define the "how" of the migration. This includes defining the following:

- **Mapping rules**
  How to map data from the source to the new data model.
- **Conversion rules**
  Where data needs to be converted, what are the rules (e.g., a material type of 01 in the source may need to be AA in the target).

- **Exclusion criteria**
  How to identify data that should not be migrated; this could be based on age, last usage, or whether a record is still active.
- **Validation rules**
  What makes a data record of sufficient quality to be migrated as-is?
- **Cleansing rules**
  Where data isn't of sufficient quality, what logic is applied to correct it?
- **Reconciliation rules**
  After data is migrated, how do you check that the migration has been successful?

Moving on to the execute phase, this is where the real work is carried out in terms of extracting and transforming data ahead of validating and loading the data. As shown in Figure 17.7, these actions are supported by an iterative cycle of quality checks and cleansing to ensure that the data is in the best possible shape ahead of being moved into the new solutions. This is where a data migration can add value by improving on the quality and depth of the data in the new solution, as good data will remove some of the barriers to adoption by ensuring that users trust the information in the system.

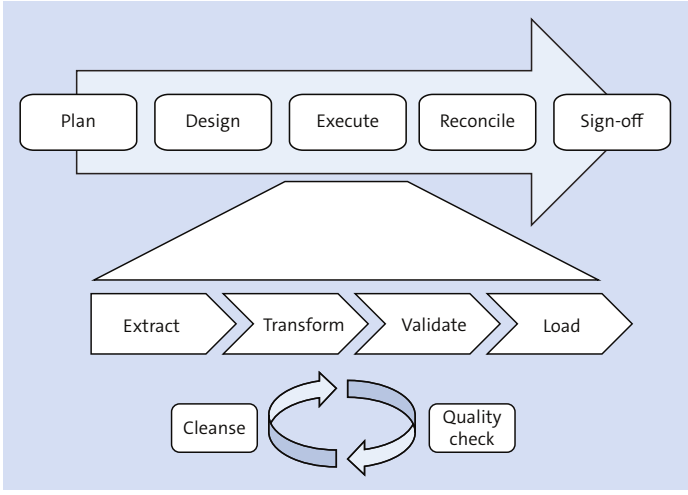

Figure 17.7 Actions within the Execute Phase of Data Migration

After data is loaded into the new solutions, the reconcile phase checks that the data has been successfully loaded, not just in terms of green lights in your migration cockpit, but that the data itself is present and correct in its new home. There are a number of ways of doing this:

- **Creation of automated validation with SAP Data Services or other tools such as SAP HANA smart data integration**
  This may be most appropriate for critical data items where other checks aren't practical.
- **Use of a reporting tool to carry out checks on the data**
  This could be through custom or ad hoc reporting. Alternatively, you can use the built-in reporting as part of the Rapid Deployment Solution (RDS) available within SAP Data Services (see Figure 17.8, which shows a series of failed records with the RDS report for **BOM Material**).

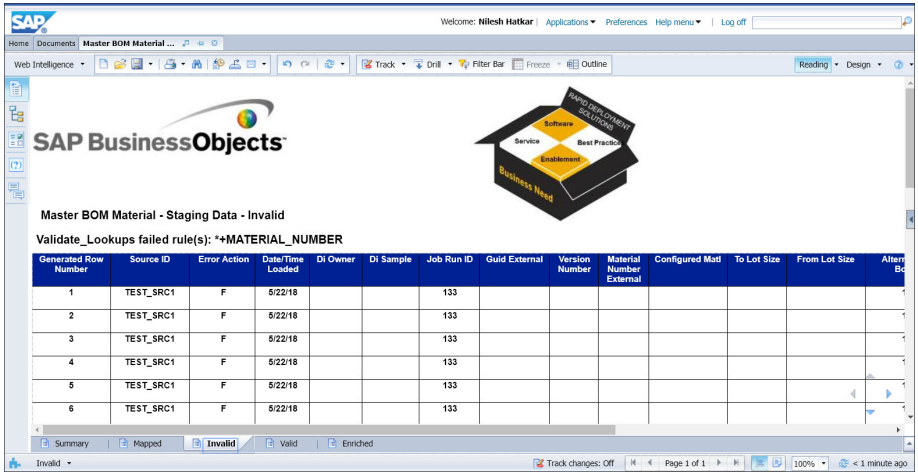
SAP BusinessObjects
Master BOM Material - Staging Data - Invalid
Validate_Lookups failed rule(s): *+MATERIAL_NUMBER
Generated Row Number | Source ID | Error Action | Date/Time Loaded | DI Owner | DI Sample | Job Run ID | Guid External | Version Number | Material Number External | Configured Matl | To Lot Size | From Lot Size
1 TEST_SRC1 F 5/22/18 133
2 TEST_SRC1 F 5/22/18 133
3 TEST_SRC1 F 5/22/18 133
4 TEST_SRC1 F 5/22/18 133
5 TEST_SRC1 F 5/22/18 133
6 TEST_SRC1 F 5/22/18 133
Summary
Mapped
Invalid
Valid
Enriched

Figure 17.8 Example of RDS Reports Showing Invalid Records for BOM Material

- **Carry out manual checks on the data in the system**
  This approach is appropriate for checking smaller reference data sets or carrying out specific record checks (e.g., on key supplier records). This approach can be augmented by small custom ABAP reports to carry out basic checks, such as the number of migrated records and so forth.

After the migration has been reconciled, all that is left is for the sign-off to take place. This is a key step in that it closes the data migration process and ensures that all elements are in place by providing a formal closure to the process.

At this point, it's sensible to outline some of the tooling options that are available and what role they can play within data migration.

17.5.2 SAP S/4HANA Migration Cockpit

While limited in scope to migrating data into SAP S/4HANA, the SAP S/4HANA migration cockpit brings a number of benefits when migrating to SAP S/4HANA or SAP S/4HANA Cloud, most of which come from the preconfigured migration content it provides. This includes templates, mappings, and automatically generated migration programs for standard objects (e.g., banks, activity types, materials, customers, and other data).

The SAP S/4HANA migration cockpit can also be extended to handle custom objects and transformations with the SAP S/4HANA Migration Object Modeler. In addition, SAP S/4HANA migration cockpit can be used in a staging mode that uses an SAP HANA instance to store data where there are significant volumes that prevent file-based migration. When everything is ready to migrate, you can view the success of each migration within your project in the cockpit itself (see Figure 17.9).

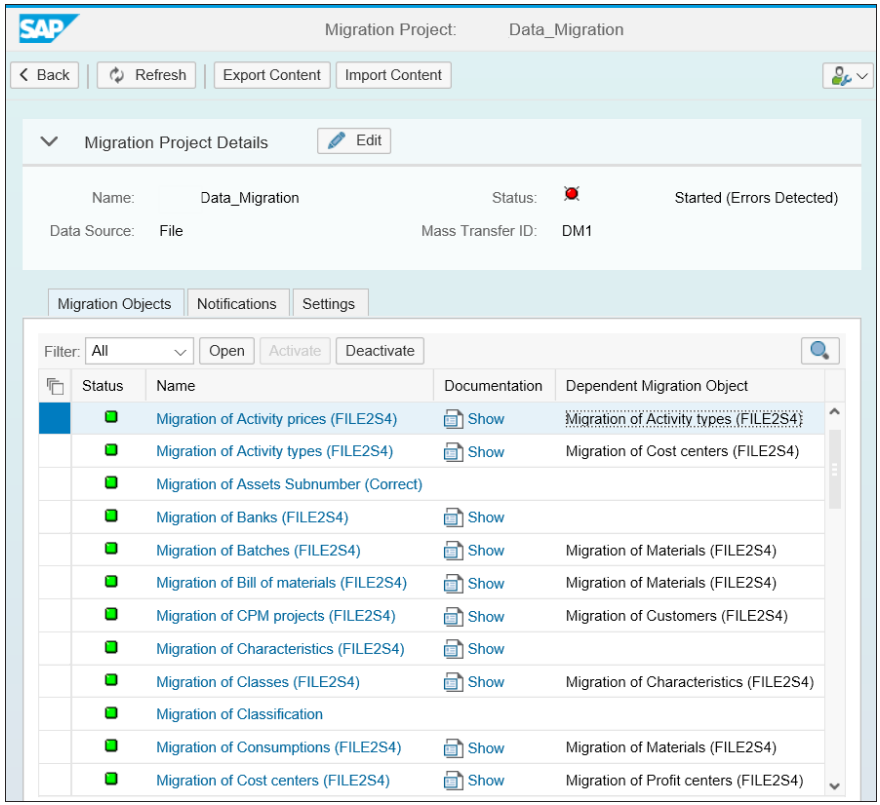
Migration Project: Data_Migration
Back
Refresh
Export Content
Import Content
Migration Project Details
Edit
Name: Data_Migration
Status: Started (Errors Detected)
Data Source: File
Mass Transfer ID: DM1
Migration Objects
Notifications
Settings
Filter: All
Open
Activate
Deactivate
Status
Name
Documentation
Dependent Migration Object
Migration of Activity prices (FILE2S4) Show Migration of Activity types (FILE2S4)
Migration of Activity types (FILE2S4) Show Migration of Cost centers (FILE2S4)
Migration of Assets Subnumber (Correct)
Migration of Banks (FILE2S4) Show
Migration of Batches (FILE2S4) Show Migration of Materials (FILE2S4)
Migration of Bill of materials (FILE2S4) Show Migration of Materials (FILE2S4)
Migration of CPM projects (FILE2S4) Show Migration of Customers (FILE2S4)
Migration of Characteristics (FILE2S4) Show
Migration of Classes (FILE2S4) Show Migration of Characteristics (FILE2S4)
Migration of Classification
Migration of Consumptions (FILE2S4) Show Migration of Materials (FILE2S4)
Migration of Cost centers (FILE2S4) Show Migration of Profit centers (FILE2S4)

Figure 17.9 The SAP S/4HANA Migration Cockpit

17.5.3 SAP Data Services

We've covered SAP Data Services in terms of its data quality capability in earlier sections; however, there are some elements of the tool that lend themselves to data migration. This includes the maturity of the various adapters and transforms that exist within the toolset and its flexibility in enabling migration to and from a variety of sources. SAP Data Services enables a migration that covers multiple targets beyond SAP S/4HANA.

Another benefit is that the implementation of various rules and transforms can be reused after your solution is live in the continual monitoring of data quality and potentially in subsequent onboarding of geographies or companies onto your new solutions.

Finally, in the same way that the SAP S/4HANA migration cockpit contains a series of preconfigured migration content, SAP Data Services also comes with RDSs that kick-start your migration to SAP S/4HANA by providing prebuilt content to enable your migration across nearly 50 standard objects. However, unlike with the SAP S/4HANA migration cockpit, SAP also offers a variety of other RDS packages for other SAP cloud and on-premise solutions (these can be found through the SAP Best Practices Explorer at *https://rapid.sap.com/bp*).

17.5.4 SAP HANA Smart Data Integration

Building on SAP HANA smart data access, SAP HANA smart data integration offers additional capabilities in terms of connectivity and transformations, allowing it to support extract, transform, load (ETL); extract, load, transform (ELT); replication; and virtualization methods of data integration. As part of the SAP HANA stack, SAP HANA smart data integration is available both as part of SAP Cloud Platform (where SAP HANA is provisioned) and on premise with an SAP HANA instance.

SAP HANA smart data integration comes with a set of adapters for connecting to SAP applications, databases (both SAP and third-party), OData sources, files, and big data stores (e.g., Hadoop). This is combined with the ability to transform and load data into both SAP HANA and other solutions using the provided adapters, and it can also make use of functionality from SAP HANA smart data quality, which we've touched upon in Section 17.4.

While this sounds broadly similar to the capabilities of SAP Data Services, there are some fundamental differences in that SAP HANA smart data integration supports real-time replication and the virtualization of data in SAP HANA, alongside bulk and

batch operations supported by SAP Data Services. In practice, you can use these tools in combination or adopt either as a single platform should you not have a case for making use of both. However, note that there is a significant amount of value in the SAP Data Services heritage and RDS content that will speed up your migration to SAP S/4HANA.

What's Right for You?

We've mentioned the RDS migration content that comes with SAP Data Services more than once in this chapter, but you may be wondering what exactly it is and whether it will help you. In short, the RDS content is a set of predelivered templates, transformations, and reports for the most common data objects in SAP S/4HANA. Using this content, you can kick-start your migration and focus development effort on the objects not covered by an RDS.

17.5.5 SAP HANA Smart Data Quality

SAP HANA smart data quality provides data quality and governance functionality, often in combination with SAP HANA smart data integration. Although discussed in Section 17.4, SAP HANA smart data quality can also be used within data migration activities, particularly when looking to enhance data sets with geocoding or carry out address validations. SAP HANA smart data quality can also be used to profile data, which can help within the plan and design phases of a data migration.

We briefly mentioned the real-time capabilities of SAP HANA smart data integration earlier, which are matched by SAP HANA smart data quality, but why would this relevant to a data migration, which is normally a one-off exercise? One area in which this could make a difference is in minimizing the gap between stopping your existing systems and going live with the new solutions. By handling most of the nontransactional migrations up front, you could use these real-time capabilities to "mirror" key data objects from your legacy solutions to your new SAP HANA-based solutions. Come switchover time, you'll have the latest snapshot of data in the new solution—cleansed, validated, and transformed in real time.

Out with the Old

Here we want to outline some of the less standard options that may well be familiar approaches but are either on their way to being depreciated or are no longer the preferred approach. We'll start with the Legacy Systems Migration Workbench (LSMW),

which is a stalwart of SAP ERP since R/2. Although still part of SAP S/4HANA, LSMW uses a number of interfaces with SAP S/4HANA that may not fully support new data models and approaches, so its use for data migration is no longer recommended by SAP.

Next, the old favorite of taking data in a flat file and writing an upload program in ABAP has been superseded by the various tools detailed previously. This method should really not be considered given the reliance on the developer to pick the right methods and programs to load the data against the standard migration content provided with a number of the tools discussed earlier.

17.6 The Road Ahead

In this chapter, we've covered a lot of ground by looking at where SAP is in terms of supporting data governance, data quality, and data migration. SAP offers a number of options in most of these areas, which leads to a lot of questions about what is the right approach for your organization. In this section, we'll take a look ahead to try and bring these options together.

Beginning with SAP MDG, it's clear that SAP is moving this product forward in terms of UX (with further adoption of SAP Fiori and mobile frontends) and backend integration with SAP HANA (by further embedding the functionality of SAP HANA smart data quality and SAP HANA smart data integration). Functionally, SAP MDG will continue to be expanded in terms of coverage of governance for SAP Cloud Platform applications, and business networks such as Ariba Network, offering data governance to the full SAP portfolio.

SAP MDG will continue to enable both passive and active governance through the central governance and continuous consolidation of master data. The end goal is to have a single platform that supports all domains and approaches to data governance within embedded analytics for stewardship and monitoring, and alongside automation of governance activities using machine learning to detect data issues and remediate them.

With SAP HANA smart data integration and SAP HANA smart data quality, there is a drive to widen the connectivity options opening up for source systems to the application. Alongside that, SAP is looking to improve the running of these solutions in business as usual (BAU) by bringing monitoring and operational content into the SAP

HANA cockpit. It's worth noting at this point that we haven't talked about SAP Cloud Platform Integration with SAP Data Services, as we see this product significantly overlapping with SAP HANA smart data integration and eventually SAP HANA smart data integration becoming the de facto tool for data movement type activity within SAP Cloud Platform.

In terms of functionality, both are being extended. In the case of SAP HANA smart data quality, this includes the addition of a best record transform, proximity matching, and a point of interest search. In terms of data enrichment, built-in integration with SAP Data Quality Management, microservices for location data, and other third-party enrichment services will be added. Within SAP HANA smart data integration, new functionality extends to a new validation transform, various enhancements to support spatial data, and a move toward enabling self-healing data movements. Therefore, by using the features of SAP HANA smart data integration and SAP HANA smart data quality, data movements will ensure that data consistency, verification, and remediation take place, leading to better data quality and operational effectiveness.

We've already touched on the overlap between SAP Data Services/SAP Information Steward and SAP HANA smart data integration/SAP HANA smart data quality, but it's worth reiterating that SAP is backing its customers' investment in SAP Data Services/SAP Information Steward with its own investment in the tools. This is initially focused on two main areas: building out-of-the-box adapters for the latest technology and enabling the toolsets to work across both on-premise and cloud applications. In terms of connectivity, the focus isn't just on SAP technology, with SAP HANA smart data quality, SAP HANA smart data integration, SAP S/4HANA, SAP Vora, and SAP HANA 2.0 being added, but also on other emerging technologies such as support for NoSQL and open source applications.

Digital Disruptor

One technology that we haven't addressed in this chapter is the emergence of the SAP Data Hub. With SAP Data Hub, SAP is addressing the growing complexity of the data landscape with big data, Internet of Things (IoT), and the proliferation of cloud services as key drivers to that complexity. It also signals a different approach from SAP because by embedding data quality and governance into the data pipelines that connect the data landscape, these activities become an automated and built-in part of the landscape, rather than retrospective actions.

SAP Data Hub itself looks to provide for data landscape management, data discovery, data pipelines, self-service data preparation, and the execution of data-driven processes. In doing so, it draws upon the majority of the technologies found in this chapter, with the functionality of SAP HANA smart data integration, SAP HANA smart data quality, SAP Data Services, and SAP Information Steward key to the enablement of SAP Data Hub's aims. SAP Data Hub also draws on other technologies we haven't covered here, including SAP Landscape Transformation replication server (SLT), SAP Agile Data Preparation, and SAP Vora.

To conclude, SAP has recognized that the data challenges previously hidden and dealt with by BAU activity won't be so readily managed in the emerging and highly complex data landscapes of the next generation of enterprises. The result of this is the use and extension of the technologies outlined here in new and more integrated ways to both address those challenges and simplify the data landscapes of the future.

This concludes the data section of the book, so we'll now turn our attention to the integration of the various applications covered thus far in the next chapter, before concluding with a discussion of administration.

PART VI

Integration and Administration

Chapter 18
Application Integration

This chapter introduces the wonderful world of integration and why it's a key part of the next generation of SAP-enabled enterprises.

So far, we've dealt with the various SAP solutions that will enable the business processes that will run the next-generation enterprise. In this chapter, we'll address what is traditionally considered a "techie" topic: application integration.

Application integration is the connection of business applications together to enable homogenous business processes across multiple applications. SAP provides several solutions that allow business processes to expand beyond the borders of the enterprise to bring customers, suppliers, and partners into your business processes.

We'll also cover SAP solutions that focus on providing insight and intelligence into the way in which processes are executed in real life and how they are operating in real time. Here we'll break from the business case we've built up over the course of the book to better illustrate the capabilities of these solutions and how they can add value to your business.

While this chapter covers a number of topics, the main building block is an interface, which we're defining here as *the transfer of a business object from one system to another*. We've purposefully not specified this as the transfer of data but as a business object because that is a more accurate description given the purpose of the interface is to enable cross-application business processes.

Before continuing with the business case, let's discuss some of the current issues and challenges around application integration today:

- **Hybrid landscapes**
  With the advent of the cloud, hybrid landscapes are increasingly becoming the norm, where business applications are found both on premises and in the cloud. So, to integrate business applications, a new set of considerations are now in play in terms of how connectivity is established (and secured) between applications that are no longer in the same physical location or managed by the same company.

- **Software-as-a-service (SaaS)**
  A key part of the move to the cloud is the adoption of SaaS applications. It's difficult to integrate with them via traditional methods because they typically only allow the exchange of data via their own application programming interfaces (APIs). Those APIs are typically limited in terms of function and volumes of data that can be accessed to ensure the availability of the application for all users.
- **Speed of delivery**
  An enduring issue around integration has been that it's "too slow" or "too difficult," adding significant complexity and risk to the delivery of projects that are introducing new business functionality. In the next generation of SAP applications, one of the key focus areas is to enable business agility. To do so, application integration must also enable that agility through faster delivery of interfaces and connectivity.
- **Toolset proliferation**
  With each new application or project, new integration tools are often introduced to meet the unique integration challenge presented by each application. This leads to an integration landscape that is challenging to support and contains significant duplication in terms of capabilities and additional costs that could be avoided.

We'll start with our business case, outlining the process integration challenges faced by Bault Robotical and how the company is looking to address them. We'll then look at the three main integration technologies from SAP: SAP Cloud Platform Integration, SAP Process Orchestration, and SAP API Management. Before wrapping up with a look to the future, we'll cover the complementary process intelligence offerings SAP Process Mining by Celonis and SAP Operational Process Intelligence.

18.1 Business Case

In the application integration space, Bault Robotical sees that it has a large number of systems and services that need to share common data and functionality—both on premise and in the cloud—with a mixture of SAP and non-SAP solutions in place. The company also needs to integrate with its products out in the wild. Seeing that the company has a number of choices to make around how to implement these integrations, Bault Robotical decides to define an integration strategy to inform and govern the development of the integrations.

To create this strategy, Bault Robotical makes use of the Integration Solution Advisor Methodology (ISA-M) approach. To start with, the company defines the integration domains that are of particular importance, in this case cloud to cloud, on premise to cloud, on premise to on premise, and thing (i.e., robots!) to on premise. The company then further defines its need for the integration styles and patterns, which is covered by process invocation with any-to-any and business-to-business (B2B) patterns necessary across all domains.

After the key integration needs are defined, Bault Robotical matches these to the toolsets in place and decides on the following key principles:

- SAP Cloud Platform Integration will be the tool of choice for cloud to cloud and on premise to cloud integrations.
- SAP Process Orchestration will be the tool of choice for on-premise to on-premise integrations and any Electronic Document Interchange (EDI) scenarios as this capability is currently more advanced than in SAP Cloud Platform Integration.
- SAP API Management will be used to expose data and functionality to external parties and things where multiple consumers will be present.
- Wherever possible, predelivered standard integration content will be used.

Armed with these principles, Bault Robotical begins to integrate its applications using the technologies described in the rest of this chapter. Here we've broken with our previous convention to describe Bault Robotical's use of the technologies in each section so that you can clearly see the use case for each technology and link that to the benefits that each technology has provided for Bault Robotical.

What's Right for You?

There are a great many integration options out there, and in this chapter alone, we'll be talking about several technologies in this space, so deciding on the technology that best suits your needs is a challenge.

In our experience, the best way to address this challenge is to create an integration strategy. While there are many ways in which to create such a strategy, we've had the most success by using the ISA-M. This approach first defines the integration domains that are relevant for your business, then defines the integration styles and use cases that are key to your integration challenge, and finally matches the most appropriate integration technology to the domains, styles, and use cases that are relevant to your business (for more information, see *https://blogs.sap.com/2016/03/04/int203-integration-solution-advisor-methodology-isa-m-sap-teched-lecture-of-the-week*).

We recommend that your strategy is revisited on a regular basis to incorporate new integration domains and patterns, as well as the (inevitable) progression in integration technology.

18.2 Cloud Integration

SAP Cloud Platform Integration is an integration platform as a service (iPaaS) tool from SAP. As part of SAP Cloud Platform, which is covered in some detail in Chapter 14, SAP Cloud Platform Integration is SAP's strategic integration service to enable integration between cloud applications and on-premise systems.

As an iPaaS, SAP Cloud Platform Integration benefits from the scalability of the cloud, a secure tenanted architecture, a reduced need for on-premise infrastructure, and by being an "evergreen" service, meaning that all customers using SAP Cloud Platform Integration are on the same version and benefit from regular automatic updates, without the need to patch or maintain their individual tenants. It's this capability that has allowed SAP Cloud Platform Integration to rapidly mature from its release in 2013 to where it is today. So much so that we've moved from viewing SAP Cloud Platform Integration as relatively immature when compared to SAP Process Orchestration or other iPaaS tools to being on par and in some areas ahead of the competition within the past two years.

Out with the Old

Along with rapid technical improvements and adding functionality, SAP has also moved through a few naming iterations for SAP Cloud Platform Integration. They've transitioned from the original SAP HANA Cloud Integration, to SAP HANA Cloud Platform Integration Services, onto SAP Cloud Platform Integration Services, and finally SAP Cloud Platform Integration, which is the name used in this book.

In terms of capabilities, there is a lot of common ground between SAP Cloud Platform Integration and SAP Process Orchestration (which we'll cover in the next section); namely, it covers the key integration areas of connectivity, transformation, and routing. Here we'll cover each of these areas in turn to give you a solid understanding of what SAP Cloud Platform Integration is capable of.

Starting with connectivity, SAP Cloud Platform Integration comes with a series of standard adapters that enable connectivity to SAP Cloud Platform applications, on-premise systems, and other applications using common protocols. It's important to note that SAP Cloud Platform Integration only enables secure connectivity; you'll see that while it supports Secure File Transfer Protocol (SFTP), it doesn't enable plain File Transfer Protocol (FTP). Providing secure communications using encryption and digital signatures is a key part of providing a secure cloud application.

An overview of these adapters can be seen in Table 18.1. These adapters are supplemented by a series of third-party developed adapters made available by SAP. These can further be extended by using the adapter software developer's kit (SDK) provided by SAP for SAP Cloud Platform Integration should the need arise.

Type	Available Adapters
Technical	AS2, AS4, HTTP(S), JMS, LDAP, Mail, OData, ODC, SOAP 1.x
Application	Ariba, Facebook, Twitter
SAP	IDoc, ProcessDirect (calls another SAP Cloud Platform Integration flow), RFC, SOAP, SAP RM, SAP SuccessFactors, REST, SOAP, OData 2.0 and 4.0

Table 18.1 List of Standard SAP Cloud Platform Integration Adapters

In terms of transformation, SAP Cloud Platform Integration makes use of the powerful mapping engine from SAP Process Orchestration (Section 18.3.2). This means that not only does SAP Cloud Platform Integration make use of the years of development and testing that have gone into the engine but also developers with an SAP Process Orchestration background have a significantly reduced learning curve. Within SAP Cloud Platform Integration, mappings are configured via a graphical web-based editor (see Figure 18.1).

One of the core concepts of SAP Cloud Platform Integration is that all integrations are contained within a single integration flow (also referred to as an iFlow). This is a highly flexible object that combines the ease of use of a drag-and-drop user experience (UX) with the ability to customize the order in which things take place within the iFlow. This is especially useful when integrating with SaaS applications and the API integration patterns that are often required, for example, making multiple API calls within the context of a single integration to generate the required output. It also allows SAP Cloud Platform Integration to route data to multiple receivers and make dynamic decisions about where data is required.

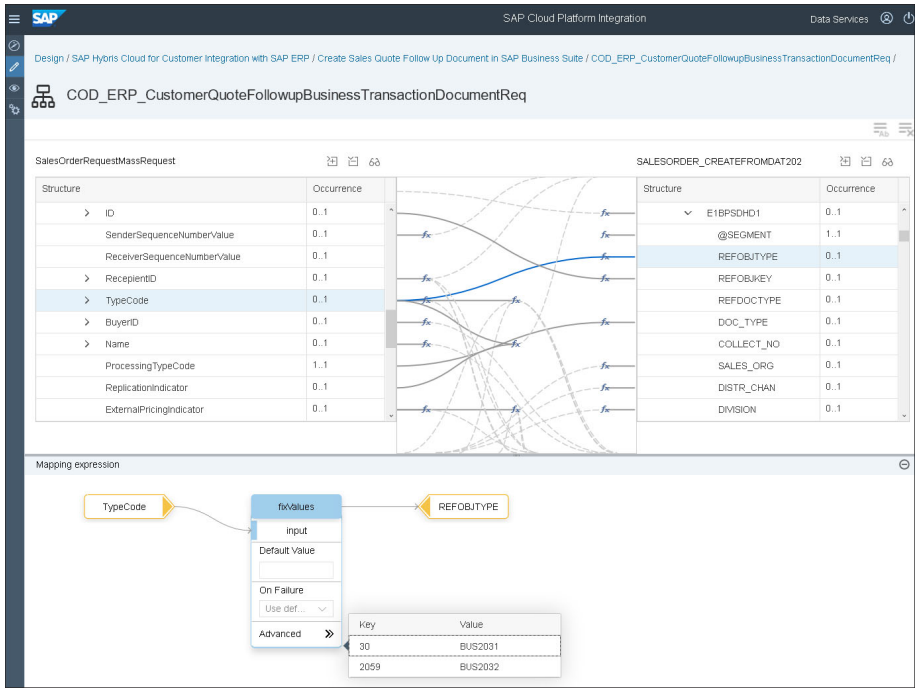

Figure 18.1 Example of an SAP Cloud Platform Integration Mapping

In Figure 18.2, you can see a sample iFlow in which a message is received from the sender via a Simple Object Access Protocol (SOAP) web service. This is then processed sequentially to two receivers with separate mappings to each receiver. In the example, SAP Cloud Platform Integration then uses SFTP to connect to Receiver A and OData to connect to Receiver B.

One of the key positives of SAP Cloud Platform Integration is the availability of standard integration content, delivered by SAP or its partner ecosystem. The aim of this content is to make integration between SAP applications as straightforward as possible, with most integrations needing simple configuration to become productive (you can also customize the content should you need to). This brings clear benefits in terms of speed of delivery, but as this content is maintained and updated by SAP (and its partners), you can also be assured that your content will remain up to date. As some of the standard content is aimed at meeting regulatory requirements (e.g., integration with the UK tax authority), this is also of great benefit. You can see and search the range of integrations available via the SAP API Business Hub (go to *https://api.sap.com*), as shown in Figure 18.3.

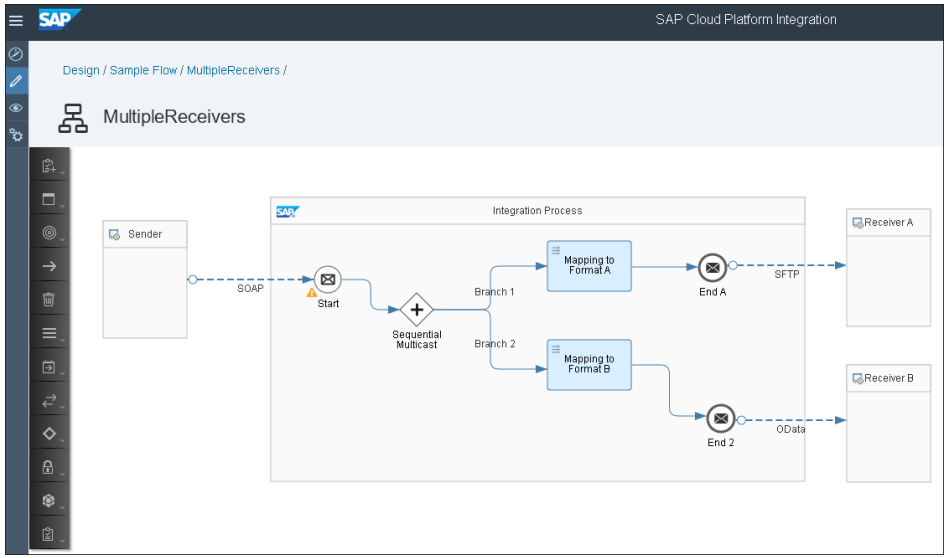

Figure 18.2 Example of an SAP Cloud Platform Integration iFlow

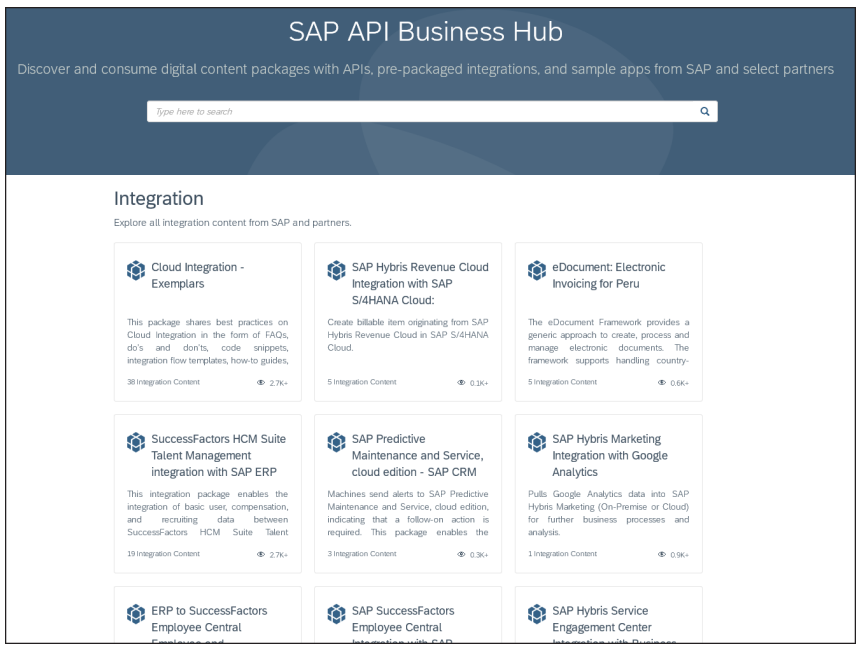
SAP API Business Hub
Discover and consume digital content packages with APIs, pre-packaged integrations, and sample apps from SAP and select partners
Type here to search
Integration
Explore all integration content from SAP and partners.
Cloud Integration - Exemplars
This package shares best practices on Cloud Integration in the form of FAQs, do's and don'ts, code snippets, integration flow templates, how-to guides,
38 Integration Content
2.7K+
SAP Hybris Revenue Cloud Integration with SAP S/4HANA Cloud:
Create billable item originating from SAP Hybris Revenue Cloud in SAP S/4HANA Cloud.
5 Integration Content
0.1K+
eDocument: Electronic Invoicing for Peru
The eDocument Framework provides a generic approach to create, process and manage electronic documents. The framework supports handling country-
5 Integration Content
0.6K+
SuccessFactors HCM Suite Talent Management integration with SAP ERP
This integration package enables the integration of basic user, compensation, and recruiting data between SuccessFactors HCM Suite Talent
19 Integration Content
2.7K+
SAP Predictive Maintenance and Service, cloud edition - SAP CRM
Machines send alerts to SAP Predictive Maintenance and Service, cloud edition, indicating that a follow-on action is required. This package enables the
3 Integration Content
0.3K+
SAP Hybris Marketing Integration with Google Analytics
Pulls Google Analytics data into SAP Hybris Marketing (On-Premise or Cloud) for further business processes and analysis.
1 Integration Content
0.9K+
ERP to SuccessFactors Employee Central
SAP SuccessFactors Employee Central
SAP Hybris Service Engagement Center

Figure 18.3 SAP API Business Hub Showing a Sample of the Prepackaged SAP Cloud Platform Integration Content Available

Let's see how this looks in our case study. As part of the implementation of SAP SuccessFactors Employee Central, Bault Robotical is going to make use of SAP SuccessFactors as the master for their organizational structure and employee data, and this data needs to be replicated to SAP S/4HANA. As the company's integration strategy also outlined its preference to use predelivered content wherever possible, Bault Robotical starts by looking at the integration content available. The company quickly identifies that SAP provides a number of SAP SuccessFactors integrations and selects the **SuccessFactors Employee Central to ERP Employee and Organizational Data** scenarios for deployment, after which the company configure the required parameters before testing and putting live the integrations on their production tenant.

Here Bault Robotical has derived significant value from its usage of SAP Cloud Platform Integration in this context, as the company has been able to not only quickly deploy a working integration solution but also receive ongoing support and updates from SAP. So, as SAP develops and improves SAP S/4HANA and SAP SuccessFactors, any consequential updates or improvements to these integrations will also be available for Bault Robotical to make use of.

18.3 Process Orchestration

Now in a book talking about the next generation of SAP applications, you may be wondering why we're covering SAP Process Orchestration at all—after all, isn't it just SAP Exchange Infrastructure (SAP XI), a plain old enterprise service bus (ESB) first released back in 2002? But bear with us, because SAP Process Orchestration in its latest form is a bit more than that.

SAP Process Orchestration brings together three powerful toolsets in one: SAP Process Integration, SAP Business Process Management (SAP BPM), and SAP Business Rules Management (SAP BRM). In essence, SAP Process Orchestration allows you to create executable business processes that harness configurable business rules and can be connected to any application or person via UI components. Now that's powerful stuff.

Now you might be trying to work out why this is important because SAP Cloud Platform Integration can do a lot of this already, especially when combined with the other capabilities of SAP Cloud Platform. The answer is relatively simple: SAP Process Orchestration still has a place in the next generation landscape because it makes integrating on-premise systems with other on-premise systems much more straightforward and avoids the proliferation of point-to-point integrations within the

enterprise's landscape (e.g., batch scripting to move files from system to system). As we've seen with SAP Cloud Platform Integration, it's entirely cloud based; therefore, integrating multiple on-premise systems together with an iPaaS that runs outside of the data center means moving data out of the network for routing and transformation before moving it back into the network to the target system. This doesn't make a great deal of logical sense.

We'll now take a closer look at the architecture of SAP Process Orchestration, before looking at each of the components in turn.

18.3.1 SAP Process Orchestration Architecture

While the intent of this book isn't to provide an in-depth guide to SAP Process Orchestration architecture, it's worth briefly outlining the architecture at a high level. SAP Process Orchestration sits on an SAP NetWeaver Application Server for Java, with an underlying database (it's of course fully SAP HANA compatible). As a Java-based application, SAP Process Orchestration is a highly extendable platform that can be architected in clusters to ensure high availability, performance, and failover. So, it can be counted on (when set up appropriately) to handle significant integration workloads reliably.

Within the simplified diagram shown in Figure 18.4, you can see each of the major components, with SAP Process Integration connecting to both SAP and non-SAP systems, as well as cloud applications and partners (known as B2B integration).

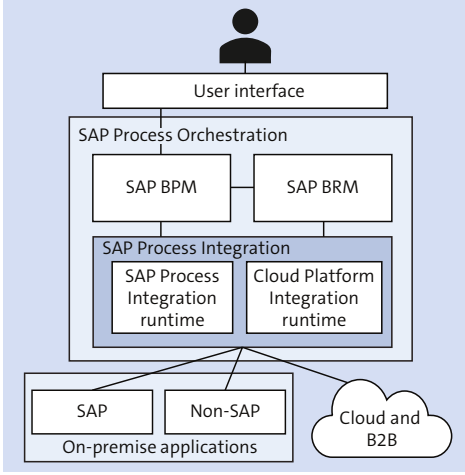

Figure 18.4 Outline of SAP Process Orchestration Architecture

You can also see the SAP BPM tool connecting to users to either gather data or seek a decision, while also consuming business rules from SAP BRM and connecting to end systems via SAP Process Integration. SAP Process Integration can also consume those same SAP BRM-based rules for use within its integration logic.

One element of the diagram that we haven't yet touched on is the SAP Cloud Platform Integration runtime, which was introduced with version 7.5 of SAP Process Orchestration. This independent runtime allows SAP Cloud Platform Integration content to be deployed and run on premise. We'll touch on the implications of this in Section 18.7.

Out with the Old

Prior to version 7.5 of SAP Process Orchestration, there has always been a dual stack architecture; in fact, this predates the Java-only architecture we describe here. So, while the dual stack system can still be found "in the wild," SAP Process Orchestration has been moving away from a dual stack architecture for a number of years.

When it comes to deploying SAP Process Orchestration, it's not essential to use or even install all of the components, as each component can be used independently from the other. So, where SAP BPM or SAP BRM capabilities aren't required, you can simply install the SAP Process Integration component as a standalone ESB.

To better understand why each of these components is important within an integrated enterprise, we'll dive into the capabilities of each element and how they can be used by expanding on our case study.

18.3.2 SAP Process Integration

The fundamental capabilities of all integration tools are present within SAP Process Integration (as we also saw within SAP Cloud Platform Integration): the ability to exchange data using standard protocols, the ability to transform data, and the ability to route data to another system.

Let's explore the integration capabilities offered by SAP Process Integration and how they are used by our business case. Then, we'll discuss a few add-ons that enable B2B integration and extend the connectivity options available within SAP Process Integration.

Capabilities and Usage

Starting with connectivity, SAP Process Integration interacts with source and target system via adapters, and each adapter enables SAP Process Integration to communicate using a specific protocol or set of protocols. Table 18.2 provides details of the standard adapters available; these are supplemented with third-party adapters that enable connectivity with other applications, such as Salesforce or Ariba.

Type	Available Adapters (italics denotes part of an add-on)
Technical	File/FTP, HTTP, SOAP, JDBC, JMS, Mail, REST, *OData*, *SFTP*, *AS2*
SAP	IDoc, RFC, SAP BC, *SAP SuccessFactors*
Industry	Marketplace, CIDX, RNIF

Table 18.2 List of Available SAP Process Integration Adapters

In terms of transformation, SAP Process Integration supports its own native graphical mapping, Java mapping (coded maps that can be executed by the runtime) and eXtensible Stylesheet Language Transformations (XSLT) mapping. By using these mappings, you can transform data from one format to another, as well convert the data itself. For instance, where system A uses the value 01 to represent a credit, you can convert this to the value CRE for system B.

The third main capability of SAP Process Integration is to route data from one system to another. While this may seem initially simple, the routing capabilities of SAP Process Integration enable routing based on message content, routing to multiple receivers, and the use of complex routing logic that has been implemented in a routing map.

So what is the point? To answer that we need to come back to our case study and Bault Robotical who is looking to integrate its on-premise SAP S/4HANA system with one of its operational systems, FiRmwarE Database (FRED). FRED is used by the R&D department to keep track of firmware versions for Bault Robotical's consumer products and requires a feed of material data to ensure that it's aligned with the material master in SAP S/4HANA. This is a task that is currently done manually, and an intern in the department has developed a REST-based API in part to avoid having to carry out this task. FRED is installed on premise and isn't accessible from outside of the network due to the commercially sensitive data it contains. As such, it's an ideal fit for integration with SAP Process Orchestration.

To get material data from SAP S/4HANA, output determination is configured to enable the relevant material data to be sent from SAP S/4HANA in the form of an IDoc (also known as an Intermediary Document, which is a standardized fixed length format to import and export data from SAP systems), as shown in Figure 18.5. When SAP Process Orchestration receives this IDoc, it identifies FRED as the receiver and maps the IDoc data into the format required by FRED. At this point, it's passed to the REST adapter and delivered to the FRED API where the relevant material record is created or updated.

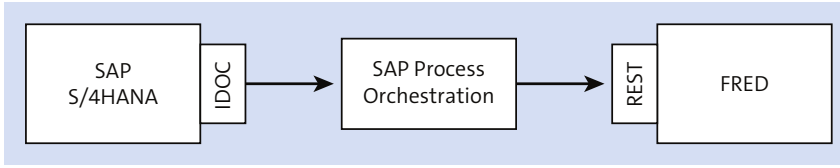

Figure 18.5 Diagram Representing the Case Study Interface

The presence of this interface has a number of benefits to Bault Robotical in that FRED is now automatically aligned with the material master record in SAP S/4HANA. The data can be relied on as being accurate, both in terms of content and timeliness, as they have removed the need to manually rekey data. It also frees up resources in the R&D department to focus on their core competency in developing and improving Bault Robotical's product line.

Add-Ons

Another key element of application integration is integrating your business processes with your partners and customers, which is especially important where you have short lead times in your process, high transactional volume, or automating a process with a partner. To enable these scenarios, SAP has released a number of add-ons to SAP Process Integration:

- **B2B add-on**
  One of the main mechanisms to enable B2B integration is the use of EDI, which consists of using a set of predefined formats and protocols to exchange data between two parties. The main benefits of this approach is the use of a common format across multiple partners to enable reuse and the concept of onboarding partners to speed up interaction with your partners.

  The B2B add-on provides SAP Process Integration with a set of B2B services, mapping templates, technical adapters, and EDI converter modules that allow SAP

Process Integration to easily work with EDI formats (e.g., EDIFACT, TRADACOMS, and ANSI X.12) and key protocols such as AS2.

- **Secure connectivity add-on**
  This add-on provides support for SFTP and Pretty Good Privacy (PGP) encryption; SFTP makes the exchange of files between two parties secure.
- **Connectivity add-on**
  This add-on focuses on helping SAP Process Integration integrate with SAP SuccessFactors through the SFSF adapter and to consume and present OData services via the OData adapter.

18.3.3 SAP Business Process Management

Often business processes don't neatly fit within a single application, but this can be resolved though individual integrations (via SAP Cloud Platform Integration or SAP Process Orchestration as appropriate). However, this isn't always feasible, so further orchestration is required to automate the business process across multiple applications. To solve this challenge, SAP BPM allows the development of executable business processes that consist of system-based process steps, human-based process steps, and decision steps.

Where your business process requires human interaction, typically to provide data or to ask for approval for an action, SAP BPM supports several UI options, including SAPUI5, Java Web Dynpro, Visual Composer, Adobe Offline Forms, and other non-SAP technologies via the Custom Technologies option. This means that SAP BPM can support your wider UX strategy and maintain the same look and feel.

Where you need to execute a step in a functional system, SAP BPM consumes web services from that system to access the functionality. Where a system can't provide a web service, SAP BPM can use the capabilities of SAP Process Integration to integrate with the target system and expose the functionality to SAP BPM as a web service. This allows SAP BPM to both query and post data within other applications, effectively orchestrating a set of activities beyond application boundaries.

Within most business processes, it will be necessary to make decisions, and we've already covered how SAP BPM can bring people into the process to make decisions. However, not all decisions require human intervention; to enable automated decisions, SAP BPM provides a set of steps to incorporate true/false decisions and event-based decisions and directs the process flow appropriately. You can also call business rules encapsulated in SAP BRM where more complex decision logic is required.

Coming back to our case study, Bault Robotical has acquired a new business, Smart Robotics, which has brought with it some new product lines aimed at scientific research (both academic and commercial), along with some overlap in the manufacturing space. As the integration of the new business is ongoing, a new business process is required to check new opportunities coming into Smart Robotics to see if they are existing customers within Bault Robotical so that the appropriate account managers can be informed.

The process will be initiated by a Smart Robotics customer relationship management (CRM) system via a web service call to SAP BPM, sending in a set of key customer data and the main area of interest. This data will then be used to query both SAP S/4HANA and SAP C/4HANA to see if a customer or opportunity can be found. If a match can't be found, then the process returns a message to Smart Robotics to continue processing the lead. If a match is found, the data is presented to the relevant account manager to confirm whether the lead should continue with Smart Robotics or be picked up by the account manager, with notification of the outcome passed back to Smart Robotics.

Here Bault Robotical is making use of both system-based process steps and human-based process steps to execute its business process across multiple systems (see Figure 18.6).

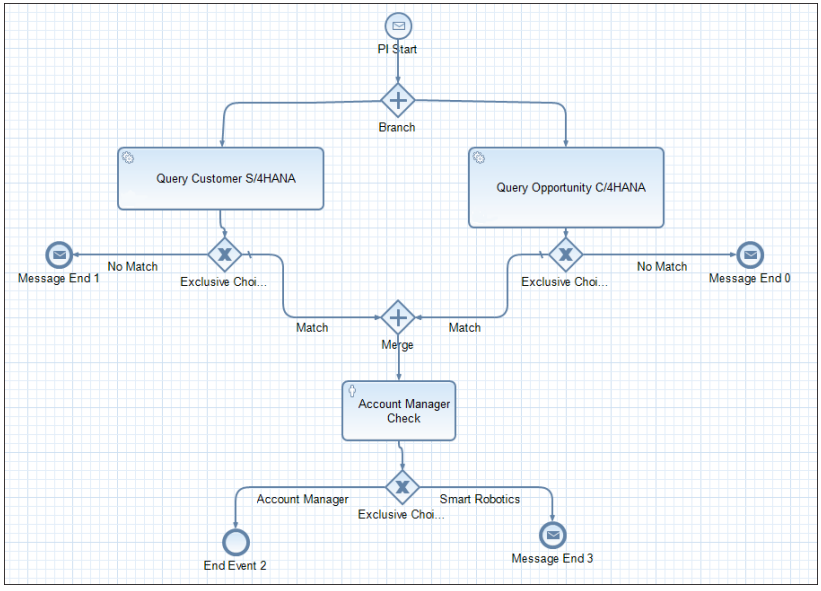

Figure 18.6 A Business Process in SAP BPM

This has ensured that a set of automated checks take place on new leads and that, where appropriate, Bault Robotical account managers are seeing the leads that they can follow up on within their existing customer base.

18.3.4 SAP Business Rules Management

A common complaint that we often hear is that IT systems are inflexible and not agile enough, and there can be many reasons for these issues, including an implementation that has been customized to such an extent that it's difficult to change, the tight coupling of applications, or simply the speed at which changes can be made in highly governed environments. Creating centralized, maintainable, and executable business rules is one way in which IT systems can be made more flexible.

In this context, a business rule is a set of logic that modifies the behavior or outcome of a business process. This logic can be driven by regulation (e.g., the need for separate approval of certain actions), business principles (e.g., ensuring that certain types of approval are always given by permanent employees), or business practices (e.g., increasing levels of discount based on strategic areas of focus).

You're probably thinking, "our applications are chock full of business rules already, so what is different about SAP BRM?" The key difference here is that SAP BRM allows rules to be created centrally and to be used across all your applications, not just within the other components of SAP Process Orchestration. These rules can also be maintained on the fly, so you're able to create logic that can be reused everywhere but that is also readily changeable.

SAP BRM consists of the following:

- Rules Composer (build)
- Rules Manager (manage)
- Rules Engine (run)

The Rules Manager is the most critical element to the creation of flexible business rules because it allows business users to modify the rules on the fly and consequently change the behavior of the consuming business process based on the changing needs of the business.

At a high level, each business rule is created as a service with a set input format containing the data needed to execute the rule and an output format containing the end result. The actual logic is contained with a ruleset that consists of rules (a set of logic and conditions) such as that shown in Listing 18.1.

```
If time = 11:00
    And
Location = UK
    Then
Timefortea = True
```

Listing 18.1 Example Business Rule to Identify Whether It's "Time for Tea"

Rulesets can also contain decision tables, which combine a number of related conditions into a table format, providing the added benefit of being easy to maintain (this can even be done via an Excel import). Table 18.3 is an example of a decision table.

Time	Location	Timefortea
11:00	UK	True
11:00	US	False
10:00	IN	True

Table 18.3 Representation of a Decision Table

You can also create more complex and dynamic flow rulesets, which bring multiple rules together into an SAP BPM-like flow that allows the output of each rule to inform the subsequent rules in the flow.

Coming back to our case study, Bault Robotical is implementing a set of marketing spend limits within the business with limits set by area of the business and the level of the relevant employee. Bault Robotical has quickly realized that these limits need to be implemented within multiple applications in its business. To meet this need, the company has decided to implement a set of business rules in SAP BPM to ensure that all applications are applying the limits consistently and giving the business the ability to flexibly adjust the limits as needed. After the business rule has been created, it's consumed by processes in SAP BPM and SAP S/4HANA.

The main benefits to Bault Robotical in using SAP BRM in this way come from the ability to modify limits based on business imperatives, for example, increasing limits for areas of strategic focus, without having to make system changes. The company can also ensure that the limits are applied consistently as all of the applications are using the same logic.

18.4 API Management

Seemingly everything has an API these days, whether it's connecting to an SaaS application, pulling live weather data from a third party, or attempting to make the robot your nephew got for his birthday dance. But why are they so pervasive, and why do we need to manage them?

Let's start with what they are; put simply an API is the gateway between the functionality and data inside an application and the applications that want to use or consume it. Think of an API as a discrete set of services that abstract the processes in the backend from the outcomes that you see. For example, when you buy some cereal in the supermarket, you just pick up the cereal; you don't have to go through the whole process of seeding and growing crops, harvesting the crop, processing it into cereal, and then putting it into a box to take home. This is a very powerful concept because to use an API, the user only needs to know about the API without being an expert in the backend that sits behind it; they just get on with building the application or integration that uses the API. This is why APIs are a developer's best friend.

If an API is a gateway, then SAP API Management is the gatekeeper because it tells people how to get in, knows who can come in, what they can access, how many times they can come in, who has been in, how many times they have been in, and if they need to pay to come in. The real business value in these activities comes from the ability to enable the usage of your APIs, ensure that the consumption of your APIs is secure and sustainable, gain insight from the usage of your APIs, and monetize their consumption.

> **Digital Disruptor**
>
> In terms of digital disruption, SAP API Management isn't necessarily disruptive in itself; however, it does make disruption significantly easier! By exposing and managing access to your company's data through APIs, you can transform not only the way in which you integrate internally but also the way in which you interact with your customers and partners. Allowing them to innovate with your capabilities in what is known as the "API economy" marks a significant shift in the way that companies interoperate.

SAP API Management covers these core activities and comes in both cloud and on-premise flavors. We'll look at the cloud version that comes with SAP Cloud Platform here, as there is limited functional difference between the two. Where you have

significant on-premise internal API requirements, then the on-premise version would be more suitable than the cloud version. Either way, SAP API Management consists of three main components:

- **API Designer**
  This component allows you to follow a "design first" approach by using the OpenAPI standard (also known as Swagger) to outline the various paths, requests, input parameters, and responses that make up your API (Figure 18.7). This component also allows you to generate stub code to speed up your development.

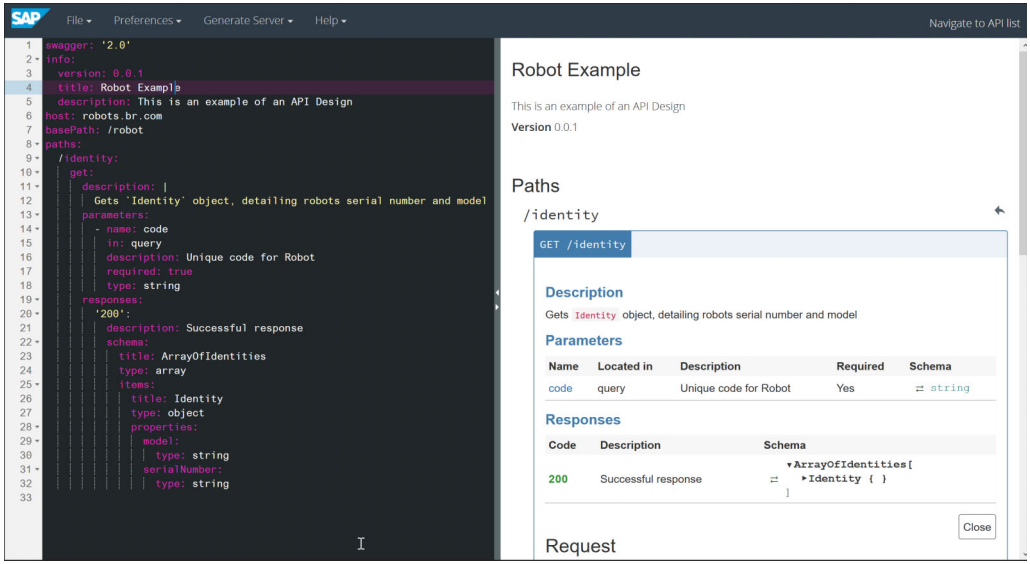

Figure 18.7 Designing a Robot API

- **API Portal**
  The API Portal is where the bulk of the configuration and build happens and where you link your API to the relevant backend services, apply policies (with a selection of Security, Traffic Management, Mediation, and Extension policies available), monitor performance, manage the monetization of your API, and grant access to specific APIs.
- **Developer Portal**
  After you've designed and deployed your APIs, the Developer Portal is aimed at both internal and external developers looking to use your APIs. It allows them to

discover, test, and subscribe to your APIs and gives them access to performance and billing information.

One thing that should be clear by now is that SAP API Management doesn't provide any of the business functionality or data that is being consumed through your APIs. It's truly the gatekeeper for your business logic and data.

Back at Bault Robotical, there's a need to allow robots in the field to check back in with the Bault Robotical mothership for firmware updates, as well as to provide diagnostic information and operational data. A central application will be created to receive and process this data, so it's important that access to this application is limited to authorized robots and that the backend is protected from being overloaded by requests or updates. As such, Bault Robotical has decided to make use of the SAP API Management service within its SAP Cloud Platform tenant.

To get this up and running, Bault Robotical adopts a design first approach and start by defining the format of the API using API Designer. This allows the company's R&D team to start building the functionality to consume the API in parallel to the backend application being created. After the backend services start to be delivered, the API format is imported into the API Portal where Bault Robotical adds an OAuth security policy to ensure access is controlled, a Spike Arrest policy to prevent the backend being overwhelmed by requests, and a Statistics Collector policy to gather key data from the requests for analysis.

While this is primarily an internal use case, Bault Robotical has still been able to design first as well as to abstract the consuming application from the API backend to speed up the delivery of the solution. The setup of policies to manage security, control traffic, and gather key data on the usage of the API allows Bault Robotical to make use of both the standard reporting capabilities and their custom statistics to monitor the usage levels of the API. The company can also carry out analysis of the data to make sure robots are checking in as expected and to see if there are any identifiable patterns for robots reporting issues.

18.5 Process Mining

So far, we've focused on application integration and the tools that can facilitate this. The next two sections will focus on technology that gives users a view of the effectiveness and efficiency of their business processes. We'll start by discussing SAP Process Mining by Celonis.

As users execute business processes, they leave a trail of bread crumbs in the form of data entries in the various database tables that sit underneath the functionality in SAP. This could be logging, transactional, or configuration data, but looking at these breadcrumbs individually in their rawest form may make little sense. However, when you link them together, you can see a plethora of historical information about a process. This is at the core of what SAP Process Mining by Celonis brings to the table.

Before we get into how this works in practice, it's worth noting that while we're focusing on SAP, SAP Process Mining by Celonis can run on any processes in nearly any system so long as the process data can be accessed.

Within SAP Process Mining by Celonis, there are two key terms that must be understood before the tool can be used properly: case and activity. A case is a single unique record in a process, and an activity refers to the steps the case goes through in the process. A case table and an activity table are created in SAP Process Mining by Celonis to gather this information on your target process.

To illustrate this further, we'll describe how this would work for the procure-to-pay process in SAP S/4HANA. Here a unique case would be a purchasing document item, with activities consisting of the events each item went through. Typically this would include creation of the purchase order, goods receipt, and invoice. To populate SAP Process Mining by Celonis, every historical purchasing document item is then pulled into the case table. The activities table would be populated in the same way but must include the timestamp of when each activity took place.

After this has been done, an entity relationship model is then created in SAP Process Mining by Celonis, which builds the relationships between the tables that tie the various bread crumbs together and are required for the historical analysis. This will normally be the case and activity tables, the transactional data tables, the configuration tables, and possibly the log data tables that are relevant to the process that is being analyzed. After this has been completed, SAP Process Mining by Celonis can really start to show its worth.

Through a completely customizable frontend, users can create key performance indicators (KPIs) to show exactly how efficient their processes are and show where any deficiencies lie.

Arguably the most powerful feature of SAP Process Mining by Celonis is the process explorer, which shows the activities that cases pass through and allows the user to identify the most common path (Figure 18.8) all the way to a view of every path that all the cases travel (Figure 18.9). Within seconds, these views can identify if there are

certain negative or undesired activities (e.g., price, quantity, or storage location changes) that cases are passing through regularly. While SAP Process Mining by Celonis can't resolve these problems, it does give you a clear starting point and helps to significantly speed up the resolution of the process deficiency.

Figure 18.8 The Most Common Process Path for Procure-to-Pay as Shown in SAP Process Mining by Celonis

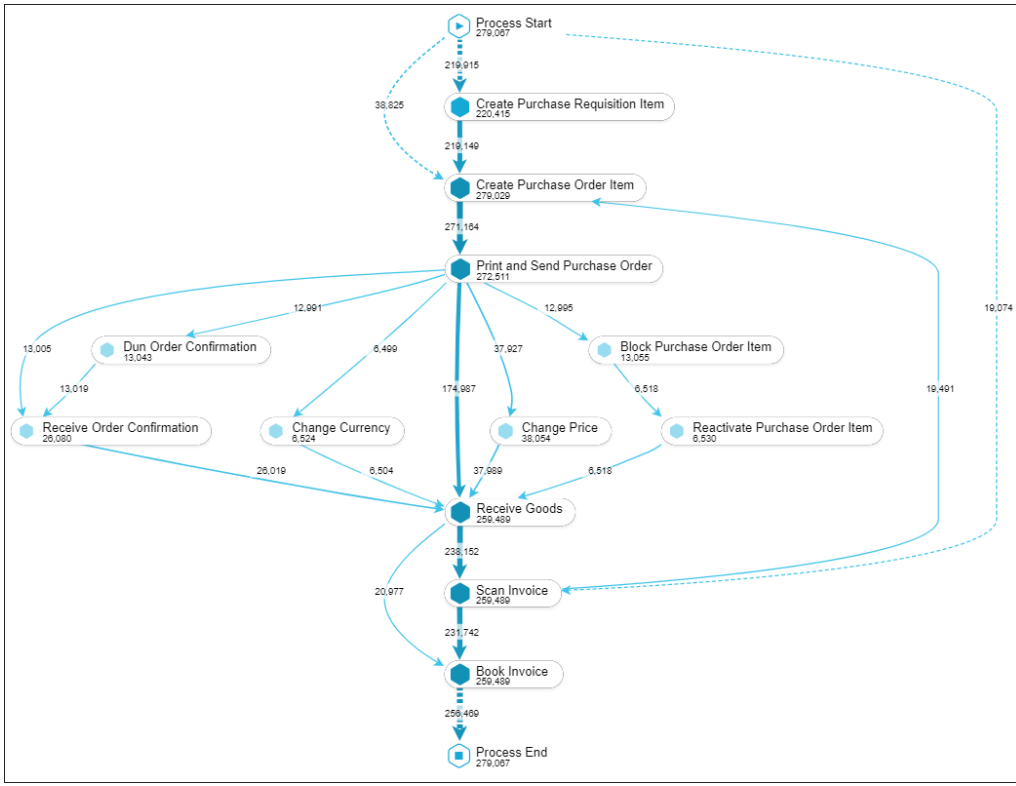

Figure 18.9 The Bird's Eye View of the Same Procure-to-Pay Process Showing All Paths in SAP Process Mining by Celonis

Coming back to our business case, Bault Robotical is concerned about the efficiency of its procure-to-pay process, so it wants to ascertain how its real-world process is performing in terms of the level of automation, manual changes, and manual rework. By default, low automation, high manual change, and high manual rework levels will cost organizations a considerable amount of money. SAP Process Mining by Celonis will provide the right level of detail on Bault Robotical's process so the company configures the various extracts and setup needed to look under the hood of how its process works.

On looking at the detail of the common paths followed. Bault Robotical identifies some key issues; at a global level, there are some repeated issues with master data

because goods receipts are regularly reworked due to entering the incorrect quantities against the wrong line items. Drilling down also reveals significant delays in processing when dealing with a specific vendor of custom cogs. These range from multiple SAP purchase order edits to delays in invoicing as fulfillment of a purchase order takes multiple deliveries. Based on these findings, Bault Robotical launches a project to improve the process for goods receipting to ensure greater accuracy through automations and better data capture. The company also begins discussions with its problem vendor to apply best practices noted from other vendors and improve the way in which the business processes interact with Bault Robotical's processes.

In this way, Bault Robotical has been able to take advantage of the insight provided by SAP Process Mining by Celonis to identify quick tangible improvements to its business process (by working with vendors with notable inefficiencies) and also longer-term process improvements in goods receipting. As a result, Bault Robotical is focusing on gaining a quick return on investment (ROI) and delivering significant business value in making some fundamental process changes.

18.6 Operational Process Intelligence

With SAP Operational Process Intelligence, businesses can get end-to-end cross-system visibility of their business processes. Sound familiar? There are some very significant differences between SAP Process Mining by Celonis and SAP Operational Process Intelligence, however. SAP Process Mining by Celonis reveals the history of process efficiency to give clear statistics and data to inform the transformation and redesign of business processes, whereas SAP Operational Process Intelligence provides live visualizations of business processes to allow users to make operational designs based on what is happening in real time. SAP describes SAP Process Mining by Celonis as the MRI for business processes, with SAP Operational Process Intelligence as the business process fitness tracker.

From the inherent capabilities in SAP HANA, SAP Operational Process Intelligence uses its capabilities to bring data into SAP HANA, process that data, and perform advanced analytics on that data—all in real time. It's fair to say that SAP Operational Process Intelligence would not be able to provide real-time insights into process performance without SAP HANA.

There are a number of key features that make up SAP Operational Process Intelligence:

- **Real-time dashboards**
  Presents real-time KPI performance and insights.
- **Process visualization**
  Ability to see the various phases and elements of the process.
- **Computation of KPIs**
  Enabled by the predictive capabilities of SAP HANA.
- **Adapters and event processors**
  Pulls and processes data in real time.
- **Rule processors**
  Automated responses or actions due to events or situations occurring in the process.
- **Notification capabilities**
  Ability to notify users when certain conditions or events occur.
- **Response actions**
  Generates requests for action.

Of these features, the real-time dashboard is the focal point for the users of SAP Operational Process Intelligence. Here they can gain a holistic view of the process in real time, can glean insights into where bottlenecks or issues are in the process, and can, critically, take action to rectify identified issues. Figure 18.10 shows this dashboard with an offer to cash process from end to end and a clear picture of the number of cycles of that process in flight, how many are in need of attention, and whether the process performance is trending up or down.

So what benefits does this bring? With SAP Operational Process Intelligence, you gain improved agility, increased efficiency, and improved process governance. The agility improvements come from the ability to respond to changing situations in the process in real time, allowing your users to identify and deal with issues as they occur rather than reacting as the impacts hit later down the line. Efficiency gains come from enabling continuous improvement based on data-driven insights from SAP Operational Process Intelligence. It's this process transparency that flags issues within your processes that can be rectified and then the subsequent improvement can be measured and quantified. Finally, the improvement in process governance comes from the transparency in which SAP Operational Process Intelligence allows

users to track process performance against targets, drill down into individual process runs, and ensure that procedure is being followed.

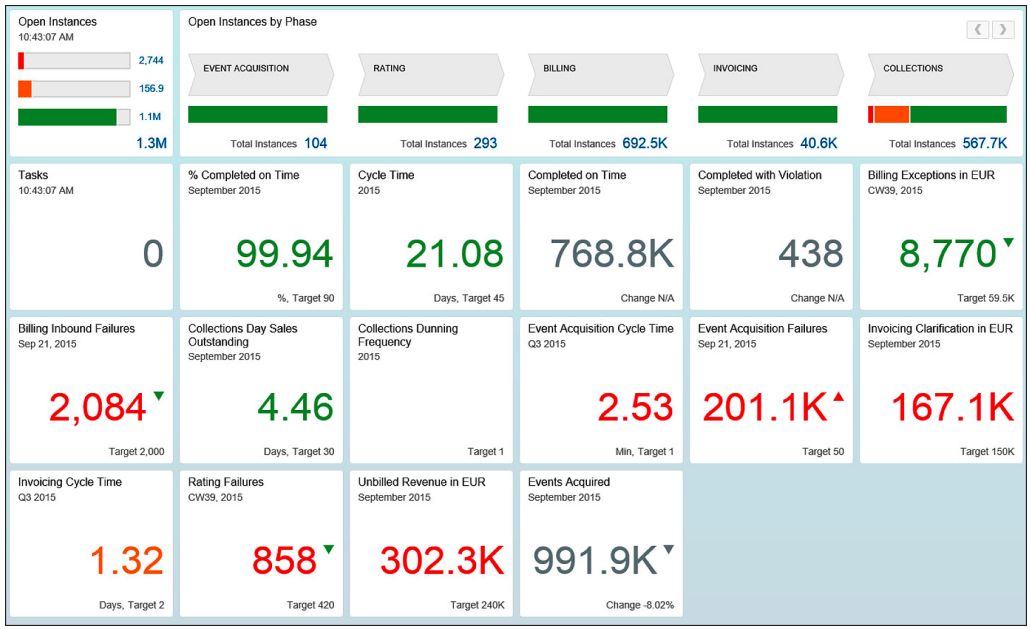

Figure 18.10 SAP Operational Process Intelligence Real-Time Dashboard

Within Bault Robotical, there are a number of key processes that cross system boundaries and have clear commercial ramifications if they don't operate as expected. As such, Bault Robotical has implemented SAP Operational Process Intelligence for its key procurement processes, as a number of their components have significant lead times so delays in the ordering and approval of these purchases has a real impact on the company's ability to meet customer delivery dates and demand.

Having configured SAP Operational Process Intelligence for these key processes, the company enables its procurement and supply chain experts to see the real-time performance of the process so that they can see where procurement is held up and either plan for unavoidable delays or get the process unblocked. At the same time, they are able to identify where the process could be tweaked. These changes lead to a reduction in the process cycle time and improved successful process rates.

18.7 The Road Ahead

Throwing our lens forward, what do we see coming in the application integration arena? We'll first deal with the integration technologies we've covered, namely SAP Cloud Platform Integration, SAP Process Orchestration, and SAP API Management, and then we'll take a look at the SAP Operational Process Intelligence tools.

When looking at the integration space, it's important to understand the context of SAP's long-term vision for the integration of its applications. SAP is looking to develop a comprehensive set of aligned APIs across its entire product set, which will mean that SAP applications will be able to seamlessly integrate with each other with minimal mediation (i.e., routing, transformation, etc.) provided by prepackaged integrations. These APIs would be available to use from an extension perspective as well as for integration.

In addition, SAP recently entered into a partnership with Cloud Elements to create SAP Cloud Platform Open Connectors; this can be seen as a move to extend the aligned API concept across vendor boundaries. SAP Cloud Platform Open Connectors enables you to normalize SaaS APIs against a generic or canonical data model, meaning that you can remove the pain from connecting SAP data models to third-party SaaS applications and reduce the complexity inherent in dealing with the various API limits implemented by SaaS vendors.

We must point out that the aligned API vision will take SAP some time to achieve, as each of their applications must be aligned semantically across all of the functional domains. So, the employee API from SAP SuccessFactors would need to tally with the SAP S/4HANA view of an employee, for example. Even with this caveat, where does this leave the integration toolsets we've covered here?

There will always be a need to mediate SAP and non-SAP integrations, although SAP is aiming to cover as many scenarios as practical with predelivered content, but the content still has to run on something! It's clear that in the long term that "something" will be SAP Cloud Platform Integration, with SAP Process Orchestration likely to eventually become the on-premise runtime for SAP Cloud Platform Integration (we also expect the SAP BPM and SAP BRM components to be overtaken by SAP Cloud Platform-based toolsets). SAP will continue to support integrations built in SAP Process Orchestration, hopefully with a migration path to the SAP Cloud Platform Integration runtime being defined over the next few years. You can see the beginnings of this with the inclusion of the SAP Cloud Platform Integration runtime in SAP Process Orchestration 7.5 and SAP Process Orchestration compatibility coming into the SAP Cloud Platform Integration road map.

Alongside this, SAP has introduced some new features that will further simplify integration with SAP Cloud Platform Integration, the first being the SAP Cloud Integration Automation Service that aims to turn the deployment of standard integration content into an automated process. The second is the integration content advisor for the SAP Cloud Platform, which is focused on simplifying the deployment of B2B interfaces by using a library of B2B standards in combination with machine learning to "suggest" the mapping required and generate the interface needed. In doing so, SAP suggests that 60% of the effort needed to build such interfaces will be saved.

In terms of SAP API Management, the main areas of focus are in improving the usability of SAP API Management in terms of delivering new APIs, onboarding and enabling consumers of your APIs, and enabling a hybrid model of SAP API Management making use of both SAP Cloud Platform and on-premise versions of SAP API Management.

This drive to hybrid and cloud-based toolsets permeates the process intelligence toolsets, with SAP Operational Process Intelligence already having these items on its road map. This makes sense as increasing elements of the cross-application business process being analyzed by these tools will be cloud based.

In our final chapter, we'll look at how to implement and run your SAP applications, focusing on the role of SAP Solution Manager in the administration of SAP environments.

Chapter 19
Administration

Now for the difficult bit—implementing and running the next generation of SAP solutions. This chapter addresses the administration of SAP with a focus on the benefits and capabilities of SAP Solution Manager.

The bulk of this book has looked at the various business processes that will run your business and how SAP solutions can facilitate and improve them. Now, before we conclude, we'll look at how SAP can help to implement and run these elements, from the conception and execution of the necessary IT projects to the day-to-day running of the solutions that run your business.

To successfully run projects, manage build, collate business processes and documentation, test solutions, manage changes and releases, monitor for errors, resolve production issues, and service the IT needs of the business, you would either need a vast array of different solutions (a project management tool, document management, service desk software, and test tools to name but a few) or a whole stack of spreadsheets! Alternatively, you could use SAP Solution Manager, which is one of the best-kept secrets in the SAP world.

If you've had anything to do with the delivery of SAP solutions over the past decade or so, you'll have likely encountered SAP Solution Manager in one of two ways: either as the tool being used to manage the transports containing your configuration and developments or as the place where you're required to load the documentation for your configuration and developments so it can be reviewed and approved (and potentially never be seen again).

However, SAP Solution Manager has evolved over time from an SAP Support tool focused on "running" SAP solutions through monitoring and maintenance capabilities, to incorporating SAP Service Management, and now in the latest version (SAP Solution Manager 7.2) focusing on business processes as a common reference point to drive solution delivery, monitoring, and maintenance.

Out with the Old

SAP has ended support for SAP Solution Manager 7.1 as of the end of 2017, so if you still have old versions of SAP Solution Manager, now is the time to get yourself an upgrade.

SAP Solution Manager gives you all of the tools you need to both deliver and run your SAP solutions via the four value chains embedded within the application:

- **Portfolio-to-project (P2P)**
  Manages the corporate IT project portfolio as well as the project management of individual initiatives.
- **Requirement-to-deploy (R2D)**
  Takes a requirement, whether as a project, enhancement, or from production support issues from idea to deployment.
- **Request-to-fulfill (R2F)**
  Provides repeatable services to the business and enables the request and execution of the services.
- **Detect-to-correct (D2C)**
  Proactively monitors SAP solutions leading to the notification of the support team to correct the issues.

We'll cover each of these in more detail in the following sections of the chapter, after we've taken a look at our business case for Bault Robotical. We'll end with a look at what the future holds for this toolset and the management of SAP applications in general.

19.1 Business Case

In the past few years, Bault Robotical has largely been focused on "keeping the lights on" within its legacy SAP solutions, and while the company has had an instance of SAP Solution Manger, it has mainly been used in the patching and upgrades of systems. Issues are normally raised by end users rather than because of any proactive monitoring of the solutions, either via a direct email to the support team or by raising a ticket in an aging Service Desk tool that is only really used by the IT Team.

Project implementation is managed with a mish-mash of tools and spreadsheets often based on the preference of the project manager rather than because of any

specific company-wide approach. This has led to some downstream issues in terms of the availability and accuracy of documentation, as well as presenting senior leadership with some challenges in terms of visibility of the project portfolio and linking the IT solutions to the business processes and capabilities they support.

As part of the proposed transformation program, Bault Robotical IT looked at how they would be able to cope with the increased workload and project velocity required, as well as how to build trust in their capabilities to manage and support the incoming solutions. It was with these aims in mind that Bault Robotical IT decided on a "reboot" of SAP Solution Manger by truly embedding it in their landscape not just as a necessary component for patching but to make full use of the features and built-in value chains that not only run the new solutions but support the implementation of the solutions in the first place.

In taking this step, Bault Robotical identified the following as the key outcomes desired from the SAP Solution Manager reboot:

- Single repository for business process models and documentation
- Adoption of SAP Best Practices both within the end solutions and the delivery of the solutions
- Ensuring a consistent approach and methodology to solution delivery
- More proactive support of SAP solutions
- Improved response to production issues due to a better understanding of the linked business processes and access to current documentation
- Greater visibility of the project portfolio in terms of pipeline and in-flight projects for senior leadership

With these outcomes in mind, Bault Robotical embarked on the installation of SAP Solution Manager 7.2 and the adoption of the tools and processes within the tool to run its transformation and solutions.

19.2 Business Processes and Best Practices

We talked briefly about SAP Solution Manager's focus on business processes and the associated SAP Best Practices in the introduction to this chapter. Before we dive into the value chains supported by SAP Solution Manager, we'll first elaborate a little further on what this focus means and how it's woven into the functionality of the tool.

Business processes are at the heart of how your organization operates, and to improve the link between IT and the business, SAP Solution Manager reflects that. Business processes are a driver for everything that happens in SAP Solution Manager, whether it's implementation of new solutions based on SAP Best Practices business processes, documentation of solutions linked to business processes, acting as a system of record for business processes, or linking business processes to the monitoring and running of your solutions day to day.

This of course starts with the business process itself, and while a process may be carried out in a system, or even across systems, such as SAP S/4HANA or SAP SuccessFactors, it should be documented somewhere. This may seem obvious, but unfortunately in our experience, it's anything but a universal practice—either documentation is missing, incomplete, out of date, or simply wasn't done in the first place. To help address this, SAP Solution Manager not only provides a tool to document your business processes but also links them to your delivery of new solutions, changes, and the monitoring of those business processes come runtime. It's the aim of SAP Solution Manager to become the single version of the truth for business processes, which benefits your business because whether you're in IT or working as part of the team executing a business process, you'll both have the same view of the business process.

You can see an example of this view in Figure 19.1, which outlines a repetitive manufacturing process for make-to-stock (MTS). The swim lanes outline the different roles in the process, with the various blocks encompassing the steps in the process. If this process is adopted, this would not only be the process followed by those resources in the mentioned roles but also the process used by IT to understand how the business works and to assess impacts of IT changes on the business.

Another focus area for SAP Solution Manager reflects a wider trend within SAP products (and projects) to provide and implement SAP Best Practices. There are two main uses of SAP Best Practices within SAP Solution Manager:

- SAP Solution Manager is meant to be used as the "master" system for business processes.
- When possible, business processes should be based on SAP Best Practices so you can jump-start your project by importing the SAP Best Practices content into SAP Solution Manager.

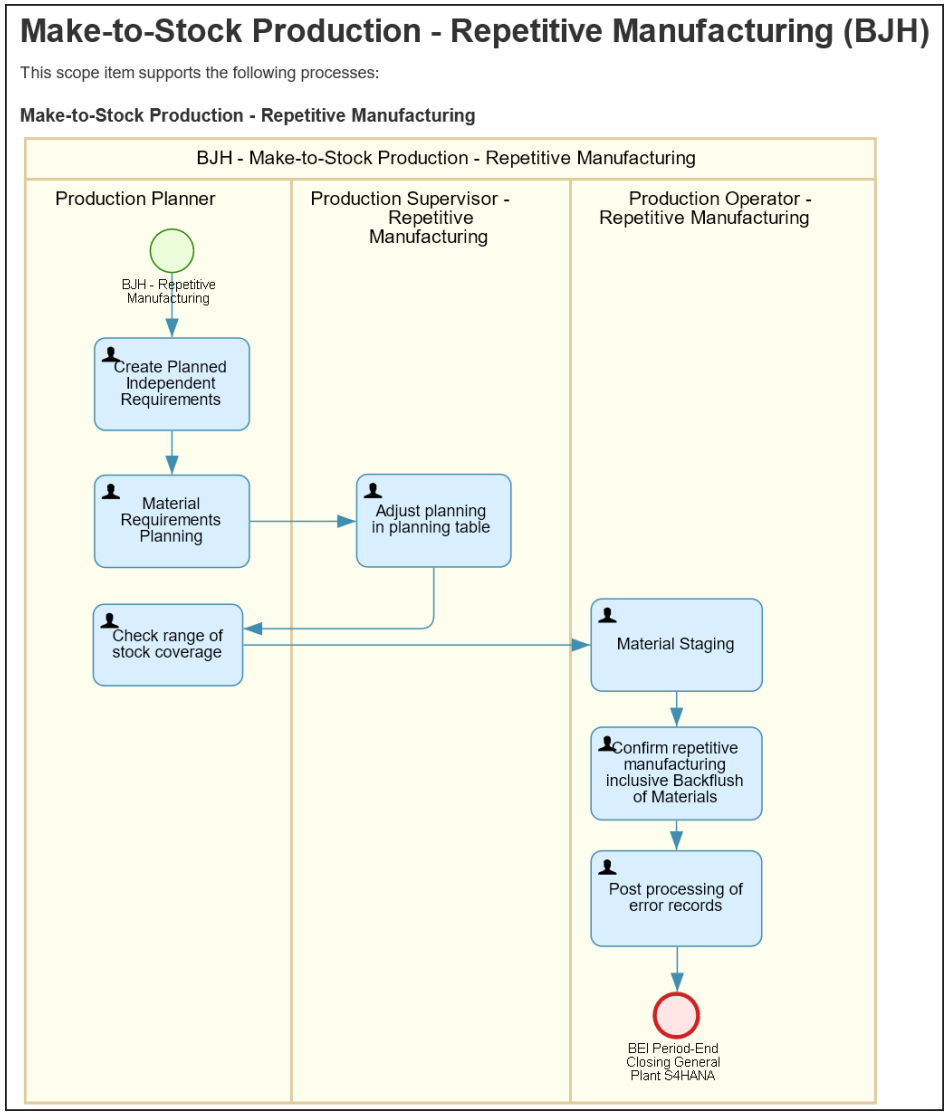
Make-to-Stock Production - Repetitive Manufacturing (BJH)
This scope item supports the following processes:
Make-to-Stock Production - Repetitive Manufacturing
BJH - Make-to-Stock Production - Repetitive Manufacturing
Production Planner
Production Supervisor - Repetitive Manufacturing
Production Operator - Repetitive Manufacturing
BJH - Repetitive Manufacturing
Create Planned Independent Requirements
Material Requirements Planning
Adjust planning in planning table
Check range of stock coverage
Material Staging
Confirm repetitive manufacturing inclusive Backflush of Materials
Post processing of error records
BEI Period-End Closing General Plant S4HANA

Figure 19.1 Example of a Business Process from SAP Best Practices

This is considered so effective that it's a key aspect of the SAP Activate methodology (Section 19.3) because being able to review SAP Best Practices against the needs of the business helps to both drive adoption of SAP Best Practices, reduce solution complexity, and lead to a more supportable solution. In addition, by bringing in the

various artifacts from SAP Best Practices, you can significantly speed up the documentation process by not having to spend time documenting preexisting SAP Best Practices.

You can also implement SAP Best Practices for SAP Solution Manager itself, which allows you to import SAP Best Practices across the value chains supported by SAP Solution Manager, including processes around project and requirements management, process management, test management, and change control management. All of these allow you to turbo-charge your implementation of SAP Solution Manager.

19.3 Portfolio-to-Project

The first value chain we'll look at is P2P, which can be seen as the very start of the journey for a new solution in terms of its inception and delivery. As you can see from Figure 19.2, there are two main blocks to the P2P chain: portfolio management and project management. We touched on these processes in Chapter 8 through the R&D lens; now, we'll take a closer look in the context of administration with SAP Solution Manager.

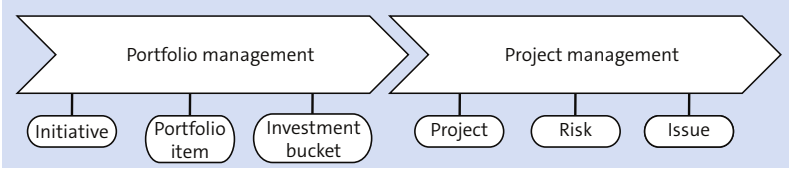

Figure 19.2 Outline of P2P Value Chain and Associated Objects

Let's explore the portfolio and project management processes, as follows:

- **Portfolio management**
  Before anyone has "broken ground" on a project, it will typically have been through an inception process, where someone has identified the need for the project, prioritized it against other initiatives within the business, worked out a cost for the project, allocated the relevant budget, and understood any impacts on other projects. In some cases, it's better to deliver an initiative alongside others, so different initiatives are merged together to reduce costs or alleviate dependencies between the initiatives.

  This is what the portfolio management element of P2P looks to encompass, using some key documents:

- **Bucket**
  The "budget" set for each portfolio of work is in essence a "bucket" of expenditures that can be consumed by various projects that will be run as part of the portfolio.
- **Initiative**
  The representation of a group of ideas or requirements with a common theme or set of outcomes (e.g., a set of ideas around improving the sales process could be grouped together as a "sales refresh" initiative). There can be multiple initiatives within an investment bucket.
- **Portfolio item**
  An individual element of an initiative that can be directly converted to projects, which can be set up and executed within the next stage of the P2P value chain once approved and signed off on. Each initiative will typically contain multiple portfolio items.

The aim of portfolio management is to give a high-level overview of the current and potential projects, which enables the selection of projects to be carried out with greater confidence. Because the comparative value and costs are known, projects can be aligned to the wider business strategy to ensure that the projects that provide the best and most appropriate outcomes are those that get off the ground. In short, it's about doing the right things for your business.

- **Project management**
  If portfolio management is about doing the right things, project management is about doing the right things right. After a project gets the green light, it will require management to prepare a project plan, manage risks and issues, control scope and budget, create reports on progress and status, and so on.

  Within the project management of P2P, the following documents are important to the process (a number of others are important in the process as well, but we're focusing on these for the sake of brevity and clarity):

  - **Project**
    The focus of project management—the project itself—represents the plan and progress of the projects with a number of linked elements such as requirements, changes, and work packages (dealt with in Section 19.4).
  - **Risk**
    Identification and mitigation of risks is a key component of project management and by capturing these in a central tool, the visibility of the risks and

mitigation actions helps to ensure awareness and the appropriate focus on managing each risk.

– **Issue**
  Inevitably a project will encounter issues, whether from realized risks or unforeseen circumstances. Again the visibility of the issues facing a project and the actions being taken against them helps with an overall understanding of the state of the project.

What else does SAP Solution Manager bring that other tools don't? For starters, it brings the combined knowledge of thousands of SAP projects in the form of fully customizable implementation road maps that can be imported into SAP Solution Manager via the roadmap viewer (*https://roadmapviewer-supportportal.dispatcher.hana.ondemand.com*). This contains both solution-specific road maps (see Figure 19.3) and generic road maps for solutions without a specific road map. Currently, this includes a road map for SAP Cloud Platform solution implementations and on-premise SAP Business Suite/other SAP implementations. Each road map is broken down into phases based on the SAP Activate methodology (see the upcoming What's Right for You? box regarding SAP Activate 101 for more information), with a baseline project plan and sets of tasks and deliverables for each phase.

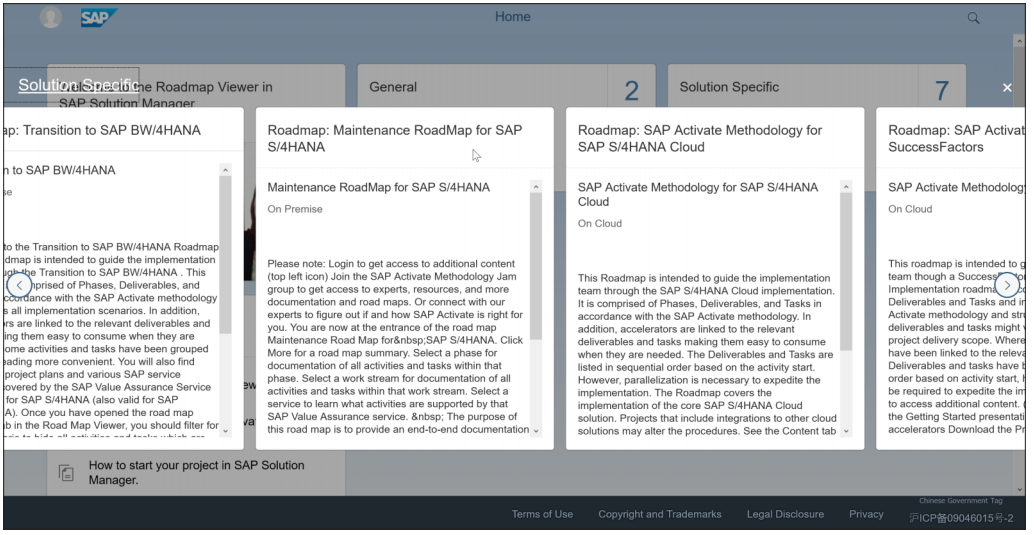

Figure 19.3 Roadmap Viewer Showing a Selection of Solution-Specific Road Maps

In addition to bringing SAP Best Practices into your implementation projects, you can also take advantage of the built-in analytics and reporting elements of project management in SAP Solution Manager. This includes progress reporting across tasks, scope reporting, quality gate acceptance, and project burndown reports. All of this helps your project managers spend time running the project rather than compiling statistics and reports.

As SAP Solution Manager offers close integration between each element of the project's execution, from the project plan down to the individual development tasks and test scripts, the process of compiling project reports becomes significantly more straightforward, freeing up your project manager's time to deliver the project effectively.

What's Right for You?

SAP has long provided project methodologies to assist its customers in deploying SAP products. An SAP Activate approach may be right for you if you're looking to use as much of the standard SAP Best Practices as possible and to minimize your customization and development to gaps that will support critical business and regulatory processes. That isn't to say that this the only approach that can be taken; your company may have tried and tested methodologies that it trusts and are well understood.

The SAP Activate methodology is relatively simple with each phase having no more than 10 key deliverables. The four core mandatory phases are described here:

- **Prepare**
  This phase is designed to get the project going on the right footing. The project environment should be established with team roles and responsibilities defined. Transition planning and preparation should be delivered.
- **Explore**
  Fit/gap analysis workshops are performed by the project team and the business to identify what must be added to the standard system to support the business requirements. Strategies and designs are defined for the work streams to take into the next phase.
- **Realize**
  The solution is built up in sprints based on the backlog. Cutover preparation, integration testing, and user testing take place during the sprints, and the go-live process can't start until all the testing has been signed off on.

- **Deploy**
  Focused around getting the organization ready for go-live along with the cutover to production. End users should be trained, and the organization should be ready for using the system productively.

The optional discover phase and run phase bookend the preceding phases depending on the needs of the individual project. Discover is used to introduce your business to SAP S/4HANA and help to focus the forthcoming project on the key functional areas that SAP S/4HANA will support. Run brings the project into the business as usual (BAU) realm and makes sure that the deployed solution is working as expected. Both the choice of methodology and what parts of a selected methodology should be used must focus on the needs of the project and the business.

19.4 Requirement-to-Deploy

The second value chain supported by SAP Solution Manager covers the actual execution activities that take place within a project and also the execution of the activities triggered by the other value chains. R2D operates at three velocities: innovate, enhance, and fix. Strategic projects come from the P2P value chain, enhancements from R2F, and spot fixes from D2C. We'll discuss these in more detail after we've first run through an overview of the value chain steps, as shown in Figure 19.4.

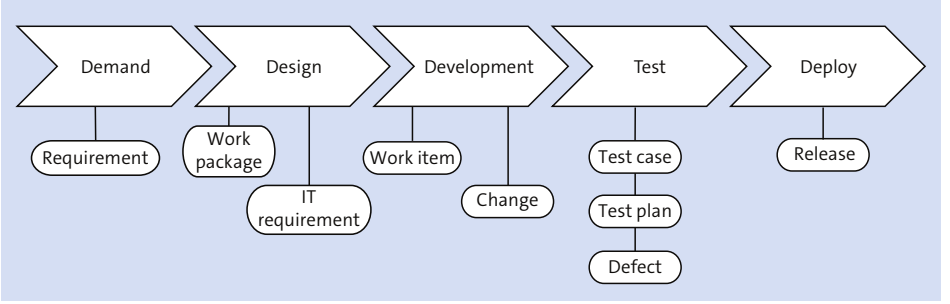

Figure 19.4 Outline of R2D Value Chain and Associated Objects

The R2D steps are as follows:

1. **Demand**
   Covering the "what" of the solution to be delivered, this is made up of a set of requirements as to what the business needs from a specific solution. This can

simply be captured as part of a run-of-the-mill requirements-gathering process or, as reflected in the SAP Activate methodology, you can start with looking at SAP Best Practices and then build requirements around where your business needs additional functionality or process steps based on gaining a competitive advantage or mandatory requirements (such as those necessitated by a regulatory body).

In this latter approach, the use of the process management functionality embedded within SAP Solution Manager comes into its own, as this allows you to browse and import the relevant SAP Best Practices into SAP Solution Manager. You can then look through the detail of the process flow and associated documentation to identify if it covers what you need and where you may need additional tweaks to make the SAP Best Practices work effectively for your business. Section 19.2 talked about the business process focus of SAP Solution Manager and how SAP Best Practices can be pulled into SAP Solution Manager. With the appropriate configuration, it's also possible to then execute the process within a system for a hands-on look at the processes in detail.

Regardless of approach, SAP Solution Manager captures your requirements during the demand step. Requirements can also come from the R2F value chain in the form of service requests or from D2C because incidents require changes to the system.

2. **Design**

   Now that you have your requirements, they need to be organized into sets of activities for delivery. These are captured as work packages within SAP Solution Manager with each work package encompassing requirements from the business. The work package allows you to break the delivery out into separate chunks to be handled internally or allocated to your preferred suppliers; for example, you may have a set of requirements around enabling a third-party payroll with data from SAP SuccessFactors, which could be handled within a single work package or could be split into a functional work package to handle any configuration needed in SAP SuccessFactors and an interface work package to handle the data exchange with the third party. Each package could then be handled by separate parties, but importantly progress is monitored centrally via SAP Solution Manager in the Solution Readiness Dashboard.

   At this point, as the design of the solution is being worked through, you may start to identify IT requirements that will enable your solution to operate. Continuing our SAP SuccessFactors Employee Central Payroll example, this may be the need to

enable a network route between SAP Cloud Platform Integration and the third party or, alternatively, if new hardware or services are needed to enable the solution.

3. **Development**
   Armed with requirements and a design, you can start the actual development activity, further splitting the work packages into work items allows the configuration and build elements of the development to be specified and allocated out for delivery. The work item is a key document in that it's a single point to hang a number of other activities and artifacts off of. In terms of making changes to systems, the required transport requests can be created and linked to the work item, and design documentation, unit tests, and other documentation can be attached to the work item. You can also use the work item to report progress and aggregate that view upward to a project level.

   The development process is expected to be iterative with continuous business feedback built in to the SAP Activate methodology because such changes should be expected and welcomed in that they enable the end solution to deliver enhanced value to the business. This process also helps with business engagement and a sense of ownership of the solution that again leads to greater value being derived from the end product. To ensure that this is properly captured and controlled, the change document is used to capture the proposed change, the necessary information to execute the change, and the business reason that necessitates the change. Each change can then be accepted into the solution and developed or alternatively postponed to a later point or rejected.

4. **Test**
   A key part of any delivery is to test it to see if the solution actually does what everyone expects it to do. The test step of the R2D value chain focuses on just that with the following three key documents:

   - **Test case**
     To effectively test your solution a set of test cases will need to be defined, which are essentially a set of inputs to your solution and the expected behaviors. Test cases can be reused across multiple test plans and can also be defined manually or are imported as an artifact of an SAP best practice. So, if you're adopting an SAP Best Practices process in your solution, the test cases may well be available as part of the SAP Best Practices, which you can use as-is or extend to suit your testing needs.
   - **Test plan**
     To represent the set of tests that need to be executed to confirm that a solution

is fit-for-purpose, you'll need to create a test plan that will consist of a series of instances of different test scripts. The execution of these test scripts can be tracked in SAP Solution Manger, both as part of the testing functionality and aggregated up into the Solution Readiness Dashboard. Each test plan is specific to a set of delivery and is fully integrated with other documents and value chains within SAP Solution Manager, so should you need multiple iterations of testing in your delivery, you can create different test plans to capture the different iterations of testing.

- **Defect**
  One of the inevitable outcomes of testing is that you'll find an issue eventually! This is the fundamental point of testing so this isn't something to be surprised by, and SAP Solution Manager provides the defect document, which captures the issue and can then be reviewed and resolved by the delivery team. Each defect can also be tracked within SAP Solution Manager as part of the overview of solution readiness.

Accompanying this value chain is a set of tools and capabilities that can be used to improve and ease the testing process. This includes the Business Process Change Analyzer, which allows you to take your technical bill of materials (BOM) that represents your existing solution and then run an analysis against a proposed upgrade, set of patches, or even a transport request and automatically generate a view of the impact of those changes on your productive system in terms of business processes that may be impacted.

SAP Solution Manager also provides a Test Automation Framework, which allows you to plug third-party test automation tools into SAP Solution Manager to enable the scheduling of automated tests, the integration of test status reporting, and the assigning of systems to tests, among other things. This is another good example of how SAP Solution Manager is open in terms of using other tools to provide additional capability.

5. **Deploy**
   After your solution has been taken from the initial requirements through design, development, and test, it's ready to go live! The deploy step of R2D handles this by linking your work packages to a specific release, and using the release management capability of SAP Solution Manager to give an overview of release readiness and execute the deployment of the solution within your application landscape.

SAP Solution Manager allows you to define how you want to manage the release of change into your landscape via a major/minor release model (see Figure 19.5).

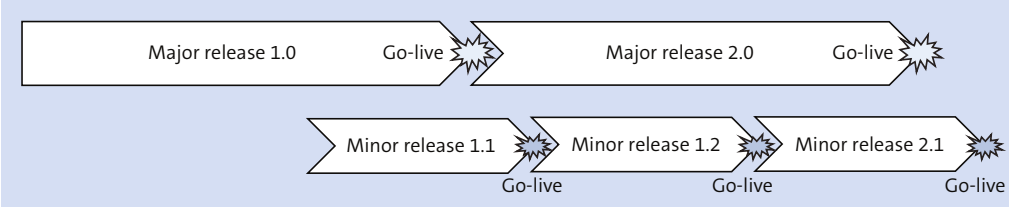

Figure 19.5 Example Release Model

Major releases are used to deploy significant changes and new solutions to the productive landscape; these typically have a longer horizon and will consist of multiple projects and some significant enhancements. Minor releases will occur periodically between major releases and typically operate in parallel. They are used to deploy smaller projects and enhancements with minimal impact on the rest of the solutions deployed in production. This model gives you the flexibility to deploy low-impact changes and solutions quickly, while still providing a significant level of control over larger and more impactful demands.

As you would expect within any enterprise, it will be necessary to deploy changes to your solutions at different speeds. These can be defined as follows:

- **Innovate**
  Significant changes to a solution or the introduction of new solutions via projects.
- **Enhance**
  Planned changes to solutions that aren't significant enough to warrant a project but still require governance to deploy.
- **Fix**
  Small changes triggered by issues in the productive solution; these can have very high velocities depending on the business criticality of the issue.

In each of these cases, the R2D value chain comes into play to ensure that the changes made to the solution are governed and done in a way that doesn't cause more issues than they solve! Each type of change comes from a different starting point within the value chains of the SAP Solution Manager lifecycle with innovate triggered from P2P, enhance from R2F, and fix from D2C.

What's Right for You?

SAP Solution Manager contains a raft of features and options that can be used to manage your delivery, but how do you get started? Well you can either install SAP

Solution Manager and then configure the various value chains and so on to suit, or you can deploy a focused solution.

Focused solutions are turnkey solutions that set up SAP Solution Manager for your specific purposes and provide the accompanying methodologies and training needed to make use of the setup. For example, the Focused Build for SAP Solution Manager solution will configure SAP Solution Manager to enable digital transformation delivery. By covering the P2P and R2D value chains, it provides predelivered dashboards to manage your delivery, set up for work packaging and assignment, risk and issues management, testing, and the management of change through releases.

As with other focused solutions for SAP Solution Manager, this service is paid for on a monthly basis by the user; this additional cost allows you to get started quickly and make the most of the benefits we've outlined in the chapter around solution delivery without additional configuration and setup effort in SAP Solution Manager.

19.5 Request-to-Fulfill

While the first two value chains are focused on bringing new solutions and functionality to your productive landscape, the R2F value chain is more focused on the BAU activities required to manage your solutions on an ongoing basis. Specifically, R2F focuses on provisioning, requesting, and fulfilling repeatable services within your IT Landscape, as shown in Figure 19.6.

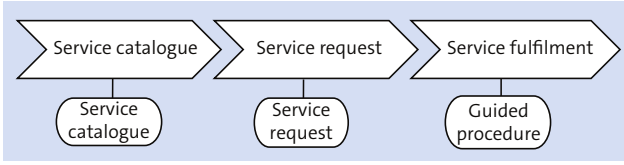

Figure 19.6 Outline of R2F Value Chain and Associated Objects

Let's take a closer look at each part of the value chain, as follows:

1. **Service catalog**
   The first aspect of the R2F value chain is to make the services offered available to the potential requestors, which is accomplished via the creation of a service catalog. This object enables service requestors to identify the IT service that they require. This could be the provision of software for an end user, a network change, or even a request for an enhancement to a solution.

2. **Service request**
   After an end user has identified the service required, the user will complete a request form, which will be configured in SAP Solution Manager to capture the data required from the requestor to enable the request to be fulfilled. Once submitted, the requestor can track the progress of their request as it's fulfilled.
3. **Service fulfillment**
   Now that our requestor has found the service required and made a request, we must fulfill it. To do this, SAP Solution Manager uses guided procedures (a form of workflow) to direct and automate the underlying tasks required to fulfill a service request. This can include ensuring that the request is approved, for example, if there is a cost associated to provisioning additional software or to approve an enhancement to be turned into a requirement that will be developed and deployed within your solution.

It's in this last point that the link between the R2F value chain and R2D becomes more apparent because if you've requested an enhancement to a solution, how will it be incorporated into the release cycles? In the same way as projects are, with requirements created from the service request for an enhancement, these are then linked to a change document that flows through the development and test steps before being deployed in a minor release. This is the second speed of R2D, known as enhance, which we covered in the previous section.

19.6 Detect-to-Correct

The final value chain, and the one most commonly associated with SAP Solution Manager, is D2C. As one of the core functionalities for SAP Solution Manager is to enable the detection of issues, both potential and realized, and to ensure that action is taken. As you can see from the value chain laid out in Figure 19.7, this is achieved both through the monitoring of your solutions and by using analytics to understand and then optimize solutions.

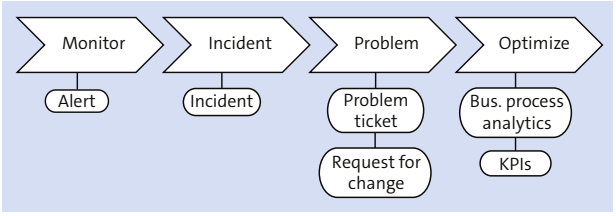

Figure 19.7 Outline of D2C Value Chain and Associated Objects

Let's walk through each step in the D2C value chain:

1. **Monitor**

   As we touched on at the beginning of this section, monitoring is one of the most common use cases for SAP Solution Manager because being able to monitor the systems that underpin your business brings significant benefits in terms of uptime and proactively preventing issues before they occur. At the heart of this component of D2C is the alerts because without notifying someone (or something), there is little point in identifying an issue. How else will anything actually happen to resolve the issue?

   As outlined in Figure 19.8, alerts require a series of detailed functionality. From diagnostic agents installed on each system you wish to monitor (with both SAP and third-party agents able to connect to SAP Solution Manager). These agents provide data to the alert store within SAP Solution Manager, where an event engine calculates whether an issue has occurred based on the slert store data and a set of metrics defined within SAP Solution Manager (e.g., the response time of a particular system or level of memory available).

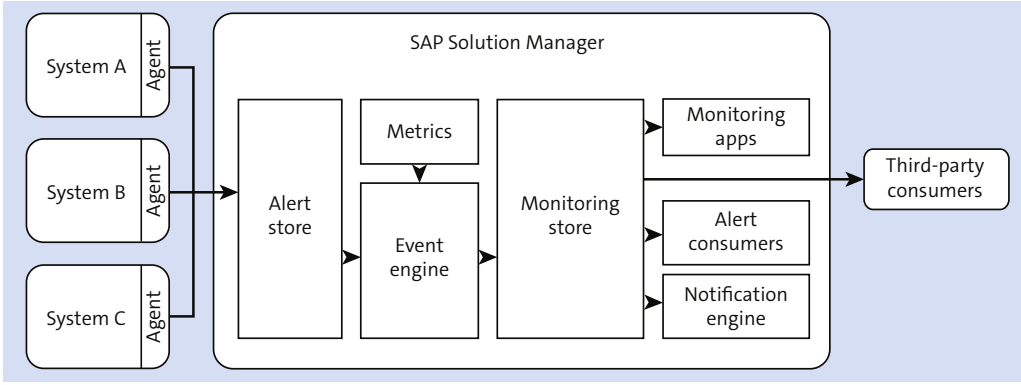

Figure 19.8 Simplified View of Alerting Process in SAP Solution Manager

   This data is then passed through to the monitoring store, whereby you can view the data through various monitoring tools available within SAP Solution Manager, including the application-specific monitoring applications available for SAP Process Orchestration and SAP BusinessObjects Business Intelligence, among others. This data is also made available to other alert consumers such as the system monitoring functionality within SAP Solution Manager and third-party consumers (e.g., incident management tools such as Remedy and ServiceNow). Alerts can also

be passed to the notification engine, which can be configured to send emails or SMS to notify individuals or teams of an issue.

2. **Incident**
   After a problem has been identified either through the monitor step of D2C, through a user reporting an issue directly, or a user reporting via a help desk, you'll then have to manage the resolution of that issue by assigning the problem to a support team or system expert or having a discussion with the individual who raised the issue. As such, the management of incidents is a key component of D2C because without it, issues would go unresolved, leading to failing business processes, unhappy users, and an erosion of trust in the service provided by IT.

   SAP Solution Manager provides its own tool in incident management to enable the creation, prioritization, and resolution of incidents, alongside the monitoring of the service-level agreements (SLA) set out to monitor and manage the performance of the IT services. This tool does all the things you would expect, from allowing the reporter to create an incident to enabling the processor to communicate with the reporter and assign the incident to the relevant processor group (after all your integration team will be unable to help with an issue in inventory management). There is, however, a large variety of similar tools on the market, some of which may well have been adopted by your organization, in which case you can continue with that tool should you so wish as you can use a standard IT Service Management interface to connect and exchange data as needed.

3. **Problem**
   While the majority of incidents will be resolved in one hit, there will be incidents that continue to reoccur or require significantly more effort to analyze and identify a root cause. In this case, a problem ticket can be created within SAP Solution Manager to look into the root cause of an issue or set of issues. This is linked to the original incident (and can also be linked to subsequent incidents) allowing the support team to look at ways of preventing the issue from reoccurring. This is an important part of the BAU support process as these repeated issues can build up over time and take up a significant amount of support effort that could be better spent on improving the solution rather than reapplying the same workaround time after time.

   After the processor has identified a root cause change in the system will likely need to be made to rectify it. When a request for change is made, the user will be back in the R2D value chain again taking the proposed fix as the demand and moving straight into development and test (as the fix has already been worked out).

Once tested, the fix can be deployed as part of a release or "unbundled" from a release should there be sufficient priority given to getting the fix into the productive solution as fast as possible. Of course, some fixes will come directly from an incident, as it won't always be necessary to create a problem ticket.

4. **Optimize**

   The fourth and final aspect of the D2C value chain is the most proactive, while alert, incident, and problem are for identifying and reacting to issues, optimize looks to carry out continuous analysis of the business processes contained within your solutions to identify potential improvements that could be made to increase the efficiency of your business processes and systems. At the heart of this, is the business process analytics functionality and accompanying KPIs provided by SAP through the KPI Catalog, which, as you can see from Figure 19.9, currently contains some 1,206 different KPIs across business processes such as **Order to Cash** and **Forecast to Replenish** (*https://go.support.sap.com/kpicatalog/*).

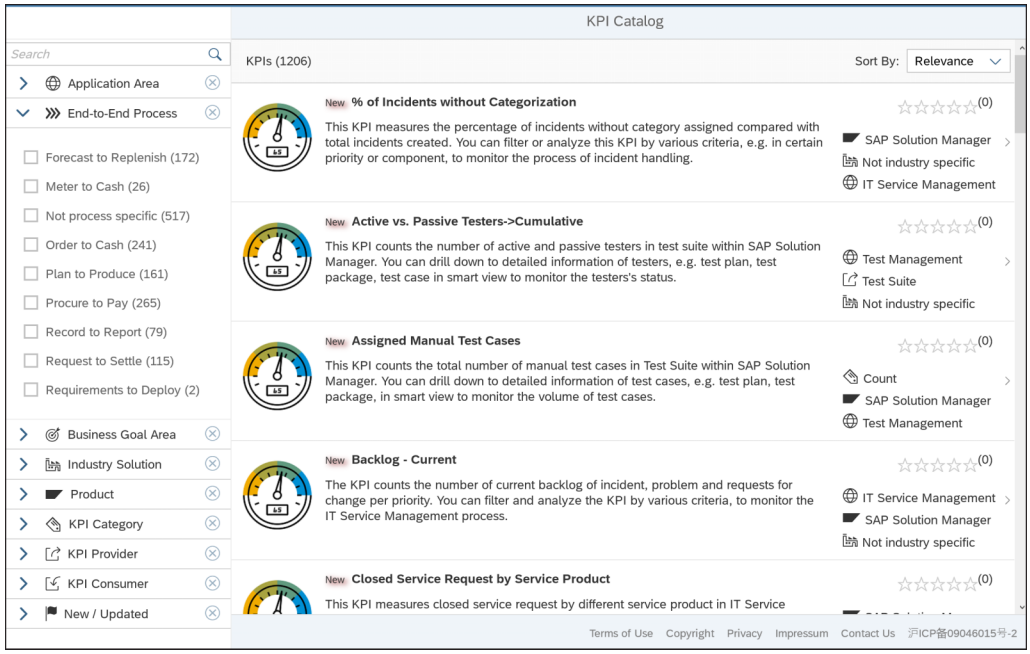
KPI Catalog
Search
KPIs (1206)
Sort By: Relevance
Application Area
End-to-End Process
Forecast to Replenish (172)
Meter to Cash (26)
Not process specific (517)
Order to Cash (241)
Plan to Produce (161)
Procure to Pay (265)
Record to Report (79)
Request to Settle (115)
Requirements to Deploy (2)
Business Goal Area
Industry Solution
Product
KPI Category
KPI Provider
KPI Consumer
New / Updated
New % of Incidents without Categorization
This KPI measures the percentage of incidents without category assigned compared with total incidents created. You can filter or analyze this KPI by various criteria, e.g. in certain priority or component, to monitor the process of incident handling.
SAP Solution Manager
Not industry specific
IT Service Management
New Active vs. Passive Testers->Cumulative
This KPI counts the number of active and passive testers in test suite within SAP Solution Manager. You can drill down to detailed information of testers, e.g. test plan, test package, test case in smart view to monitor the testers's status.
Test Management
Test Suite
Not industry specific
New Assigned Manual Test Cases
This KPI counts the total number of manual test cases in Test Suite within SAP Solution Manager. You can drill down to detailed information of test cases, e.g. test plan, test package, in smart view to monitor the volume of test cases.
Count
SAP Solution Manager
Test Management
New Backlog - Current
The KPI counts the number of current backlog of incident, problem and requests for change per priority. You can filter and analyze the KPI by various criteria, to monitor the IT Service Management process.
IT Service Management
SAP Solution Manager
Not industry specific
New Closed Service Request by Service Product
This KPI measures closed service request by different service product in IT Service
Terms of Use
Copyright
Privacy
Impressum
Contact Us

Figure 19.9 SAP KPI Catalog

Business process analytics is aimed at identifying weaknesses in your business processes, and provides root-cause analysis functionality to drive toward providing a way forward to removing those weaknesses. To do so, it draws on the KPIs provided by SAP and uses those to drive three main types of analysis:

- Benchmarking: Identify if you have a global problem or one specific to a business unit or geography.
- Age: See the time sensitivity of the issue (seasonal, linked to month-end, etc.).
- Detail list: Drill into the documents that make up the picture seen in the tool.

After an issue is identified, you can take the appropriate action, in terms of user training, business process modification, or system changes via the R2D value chain.

While this may seem unerringly similar to SAP Process Mining by Celonis and SAP Operational Process Intelligence, which we covered in Chapter 18, they do have different use cases in terms of either being a real-time operational tool (SAP Operational Process Intelligence) and providing a deep dive comparison of what process is actually being followed as opposed to the idealized view (SAP Process Mining by Celonis).

What's Right for You?

Earlier on in the section, we referenced the use of focused solutions and in particular the Focused Build for SAP Solution Manager solution for supporting digital transformation projects within SAP Solution Manager. There is also a Focused Insights for SAP Solution Manager solution available that implements a set of dashboards based on the KPIs we've just discussed. These dashboards are tailored to deliver insights at multiple levels within your organization: strategic dashboards that outline compliance with KPIs and organizational objectives, and governance dashboards that detail the compliance with set service levels and at the operational level where proactive D2C analysis can take place.

In addition to these ready-made solutions, you can also take advantage of SAP's Expert Guided Implementation (EGI) courses that come free as part of your maintenance agreement. These cover a wide variety of topics related to SAP Solution Manager and beyond, and the courses guide you through the setup and configuration of various features through remote expert led training. What is unique about the EGI courses is that you carry out the activities in your own system, so when the course ends, you've implemented the functionality and don't need to repeat any of the setup covered by the course.

19.7 The Road Ahead

SAP Solution Manager could be said to be a product of SAP's past, having been born from the management of on-premise systems and (at least initially) rooted in the ABAP stack. We've looked to remove that preconception in this chapter, showing SAP Solution Manager to be a product focused on business processes and the enablement of SAP Best Practices as a driver for simplified and efficient delivery. SAP Solution Manager embraces the cloud through the use of online data repositories to bring in KPIs, SAP Best Practices, road maps and other data objects that benefit from being maintained centrally by SAP.

So what's next for SAP Solution Manager? As you've seen from the preceding chapters, the scope and breadth of the SAP product set is constantly evolving at a rapid pace, so SAP Solution Manager must keep pace to provide a consistent service across the landscape. This can be seen as the never-ending road map item for SAP Solution Manager, as the SAP product portfolio is unlikely to stand still anytime soon!

Aside from keeping pace with the rest of SAP, SAP Solution Manager will also become more cloud-centric. Given that this is the overall strategic theme from SAP, it's somewhat inevitable that SAP Solution Manager will follow suit. Initially, this will be enabling SAP Solution Managers existing functionality for the SAP Cloud Platform applications, allowing the monitoring of cloud solutions within SAP Solution Manager, SAP Transportation Management (as seen by the recent beta of transport concepts within SAP Cloud Platform Integration), and custom code analysis within cloud solutions. Over time, we expect to see the core functionality of SAP Solution Manager migrate to the cloud, eventually becoming a full-fledged cloud product in its own right.

Conclusion

We've reached the end of our journey through the next-generation SAP landscape. Now, we'll conclude with a quick check-in with our business case and a general look at current business challenges and the future of SAP.

At the beginning of this book, we stated the aspiration that contained within the subsequent pages would be an attempt to demystify some of the vagaries, confusion, and misinformation around SAP's next-generation solution portfolio. Our aim was broad and included both the digital core in the form of SAP S/4HANA Enterprise Management but also into the wider portfolio and technologies, including products such as SAP HANA, SAP Ariba, SAP Concur, SAP SuccessFactors, machine learning, Internet of Things, and many more.

Now at the end of this endeavor, we'll close with a summary of the key themes that have been evident throughout the book and common to almost every chapter:

- Emerging business challenges
- SAP's new portfolio, and how it responds to these challenges

However, before we do, let's return for the final time to our Bault Robotical case study to understand the approaches, successes, failures, and challenges that the transformation brought; how these challenges were overcome; and what lessons were learned that could benefit others seeking to go through a similar SAP-centric transformation program.

Business Case Conclusion

We've explored the various business process through the lens of our business case, examined the challenges and goals, and discussed the SAP portfolio that best suits the company's needs. Now, let's take a look at how Bault Robotical put the pieces into place for its digital transformation journey.

Transformation Program

Having decided which SAP products to implement and begun a commercial conversation with SAP about the final product bill of material (BOM), the program of transformation began in earnest.

In the Introduction, we learned the goals of the program, which we've discussed and expanded on throughout the book. To achieve these goals, Bault Robotical began with a series of town hall events, where employees were invited to meet with senior executives to discuss the plan for transformation. In addition to outlining the goals and aspirations of the program, the underlying business need for a successful transformation was also discussed, ensuring the employees clearly understood the strategic role of the program in the future of Bault Robotical.

These events set the correct "tone" for the program by establishing the transformation as a key business priority for the whole business and one which had the full support from the most senior figures within the business. Furthermore, the goals and aspirations were presented in business terms, without mention of technical solutions. The message was clear: this was a business transformation program, and not an IT program.

Alongside the initial meetings, the program team at Bault Robotical was formed with representatives from both within the organization (business and IT) and from a partner organization who was chosen to help deliver both the SAP program elements and also the business change program elements. The partner was selected after a rigorous selection process within which Bault Robotical required responding organizations to prove experience and credentials in many areas, including the following:

- Experience of SAP implementations within a similar industry
- Experience of SAP S/4HANA transformation programmers using the SAP Activate approach
- Credentials and experience in delivering business change
- Credentials and experience with the deployment of SAP cloud products

Together with the selection of the external partner, an internal program team was formed. This team was wide, ranging from the engaged but hands-off program sponsor (the CEO, who sat on the program steering committee) through to the day-to-day members of the program team.

After the team had been formed, the underlying rules of the system transformation were being defined and enshrined. In many organizations, this is unnecessary, as often these policies and rules may already be in place. For example:

- **Enterprise architecture process and governance**
  One of the key themes of the program was to consolidate and standardize how the business operated. This looked at both the processes involved and also the technology that was adopted. At the commencement of the program, there was very little control of the systems within the landscape with different areas of the business introducing new systems (both on premise and software-as-a-service [SaaS]) into the footprint of Bault Robotical. Early on in the transformation, Bault Robotical decided to form a new enterprise architecture (EA) team that essentially set the strategies and defined and approved any new systems to be added to Bault Robotical's IT landscape. It was clearly communicated that systems not approved by the newly formed EA function would not be supported by Bault Robotical.

  Together with the sign off of technical applications and solutions, the EA function at Bault Robotical were also given the remit to define the overarching strategies that would provide binding guidance both within this program and to any other initiatives and business as usual (BAU) at the company..

  The following are examples of strategies defined by the EA function within Bault Robotical:

  - Integration strategy: The integration strategy defined the integration tools and approach in various scenarios, such as on premise to on premise, on premise to cloud, and cloud to cloud.
  - User experience (UX) strategy: The UX strategy defined an overarching approach to the UX, focusing on the adoption of SAP Fiori where practicable.

- **Data governance**
  In common with the introduction of new systems into Bault Robotical's landscape prior to the transformation, there was no central ownership or regulation of the data model. This meant that no one within the organization had the responsibility for the overall quality of the data nor did the organization have any central control processes governing the development of the data model. Early in the transformation, it was decided that a business data champion would be appointed to the program who had the responsibility of coordinating data remediation and in parallel establishing an ongoing governance structure and framework.

Very early on in the project, the team had to define their approach to the deployment of SAP solutions. From an SAP S/4HANA perspective, Bault Robotical assessed the following key options:

- **Greenfield implementation**
  This refers to a business that starts with a new, blank installation of SAP S/4HANA. While data and other elements can be migrated from an existing ERP system (SAP provides tools such as the SAP S/4HANA migration cockpit to make this easier), essentially it's a new implementation.
- **System conversion**
  For non-technical and noncommercial readers, this can be considered an upgrade from SAP ERP to SAP S/4HANA. Unlike a greenfield implementation, this is not a new implementation but rather the movement of existing functionality, data, and code from SAP ERP to SAP S/4HANA. SAP provides various tools to make this process easier; however, due to changes in the underlying data model, it does require a degree of testing. Also, depending on the scale of development, this may require rectification of the customer-specific code.
- **Landscape transformation**
  An approach for consolidating multiple instances into SAP S/4HANA. This can be thought of as a more targeted migration or combination of specific datasets.

After evaluating the various options, Bault Robotical decided to adopt a greenfield implementation. This decision was based on the fact that the company had used SAP ERP for many years, for a multitude of purposes, and had a significant number of incorporated developments both in terms of standalone programs and user exists. As a result, the system complexity had grown significantly, and Bault Robotical had moved away from SAP Best Practices. Since a migration to SAP S/4HANA was considered highly complex, and the customizations were not deemed necessary in terms of their future business processes, it was decided to start with a clean slate: a new implementation.

While selecting suitable implementation partners, Bault Robotical was introduced to two competing implementation frameworks in the guise of SAP ASAP and SAP Activate:

- **ASAP**
  SAP ASAP methodology is a waterfall approach to implementation with six defined stages. It has long been the preferred implementation methodology for the SAP R/3 and SAP ERP products.
- **SAP Activate**
  With SAP S/4HANA, SAP introduced a successor to SAP ASAP in the form of SAP Activate. While this methodology is the subject of books in its own right, it fundamentally shifts the focus from "asking" the business what it "wants" in the form of

blueprinting to determining "what gaps exist" in the standard delivered best practices.

Bault Robotical decided to adopt the SAP Activate approach to the implementation as it felt that this methodology better suited the business drive to standardize by focusing on filling functionality gaps through business (rather than system) change.

Transformation Results

As has been outlined in the body of the book, Bault Robotical was able to make use of specific capabilities within the SAP portfolio to overcome both its current business challenges and also drive toward its strategic goals. Following is a reminder of some of these goals together with an explanation and assessment of how Bault Robotical realized each of these:

- Goal: Due to a predicted revenue challenge, the business must reduce OPEX by £10 million year on year. This challenge begins in 24 months' time. Identified ways to achieve this included the following:
  - Linking field data capture directly to the backend
  - Making changes in the organization structure of Bault Robotical

  From a revenue reduction perspective, the result at Bault Robotical should be seen as positive with a significant amount of cost being removed. As expected, much of this reduced cost has come in the linking of the field force to SAP S/4HANA. Examples of this interaction abound throughout this book.
- Goal: The future strategy on the business is based on acquisition, and the business must be able to accommodate this with a minimum degree of disruption. Identified ways to achieve this included the standardization of processes to enable fast adoption of the Bault Robotical model.

  Using SAP Activate, the organization successfully adopted a standardized solution in many areas, including procurement, finance, and HR. These processes were designed specifically to comply with SAP Best Practices so that future acquisitions could be integrated quickly and in a standardized manner.
- Goal: The business wants to move to providing services rather than simply sales in certain areas. The ability to quickly adopt this business model plus other yet to be determined business models highlights a need for our future business to be agile and reactive.

At the end of the transformation, Bault Robotical now offers a robot-as-a-service where the customer is charged based on the number of hours the robot was in operation. This is one of a number of examples outlined within the book, and represents a paradigm shift in the type of solutions that SAP now offers.

Emerging Business Challenges

Having discussed our specific case study, we'll now shift our attention to some of the business challenges that have been discussed in the book:

- **New business models and services**
  The world is changing, and business is changing, and as a result, organizations need to be hypervigilant to ensure that they are both providing their customers with the correct products and services and also providing the optimal method of consuming them. More and more competitive advantage is achieved by the business model. In this book, we've discussed how Amazon has obtained a competitive advantage by optimizing its shipping processes and making next-day delivery an everyday customer expectation. However, the company isn't resting on its laurels but is looking at ever more innovative ways of maintaining this competitive advantage through the continued optimization of the model. Amazon is the most well-known proponent of drone technology under the banner of Amazon Prime Air. Amazon seems committed to the realization of this vision stating that, one day, seeing Prime Air vehicles will be as normal as seeing mail trucks on the road."
- **Changing customer expectations**
  Together with a new normal concerned with the fulfillment of orders, customers also expect the ability to personalize products with little or no impact on delivery. This expectation ranges from the ability to personalize items prior to manufacture, such as clothing, but also in terms of including "hyperpersonalized" services, such as the one offered by HelloFresh that creates individual "taste profiles" for each customer based on indications from customers about what they like and do not like.
- **Constant management of change**
  As business models change, a crucial success criteria is ensuring that the organization has the requisite capacity to meet this change. It's true that some organizations and some industries are at less imminent risk of floor-to-ceiling disruption, but when considering why Blockbuster failed and Burberry thrived

(discussed in the Introduction), we can see a common theme: organization ambition and agility. The truth is that technology can only ever provide the capacity to transform; it needs to be accompanied by the corresponding business drive, ambition, and ability to transform. Without this, all the digital technology in the world will amount to nothing.

- **Tighter integration with technology**
  Throughout many chapters in this book, we've discussed the ever-increasing role of technology in defining business processes. For example, many chapters have highlighted the Internet of Things (IoT) application suite from SAP that includes SAP Predictive Maintenance and Service, which are fundamentally changing organizations' relationships with its machines and its data.

The Road Ahead for SAP

Having considered the generic challenges faced by business, let's finally look into the road ahead for SAP.

Consider a landscape with 25 database servers. Each of them may be running a subtly different database platform, either from within the same family or from completely different vendors. Regardless, sharing data will be heavily dependent upon integration, replication, and synchronization, which brings its own pitfalls and extended technical overhead given the current inconsistent approach in these areas.

Now consider the combination of SAP HANA, and its many advanced data access and management capabilities, along with SAP's desire to move to a standardized data model. Soon, all of SAP's current products will be deployed on top of the SAP HANA platform. This potentially leads us to one of two possible outcomes:

- All SAP applications will be deployed on top of one massive SAP HANA database, with a single, common data model and the ability to share all data across functions.
- All SAP applications will be deployed on top of numerous SAP HANA nodes, with a single, common data model and the ability to share all data across functions.

There isn't a massive difference in these two options, but think of the challenges to achieve the first: all your applications would typically have to reside in the same data center, and the database platform itself must be massive to accommodate all that data. That is both financially and technically nonviable (not to mention, it's far too

reminiscent of the old architecture of all business modules sitting in one big application, otherwise known as SAP ERP).

Option 2 is more aligned with the current industry move to the cloud and "as a service" offerings. In this scenario, each application has its own data store. Currently though, this still generates the need for data replication and therefore redundancy. If we begin to add in the clever SAP HANA virtualization and federation capabilities, it isn't a massive leap to picture a virtual single database, albeit comprised of numerous physical databases. Instead of constantly moving data around, each application can make use of a common data model that is dispersed across numerous applications and their database. Due to SAP HANA offering the common data model mentioned previously, redundancy is removed, and data integration effort is virtually eliminated as a by-product. (We're starting to realize some of SAP's core principles for the intelligent suite already.)

Clearly, SAP is trying to enable a fully connected, agile enterprise where the technology layer provides the requisite horsepower to enable a suite of applications that work together to provide real-time information from workers operating in the field, travelers submitting expenses, or external organizations that are collaborating within the supply chain. However, having a fully integrated suite covering the full extended requirements of a business is only the tip of the iceberg as SAP's new portfolio is clearly aimed at also bringing together nontraditional data sources, such as IoT, and applying nontraditional disciplines and technologies, such as machine learning and artificial intelligence to fundamentally alter what day-to-day business processes look like.

Altogether, this forms the concept of the intelligent enterprise, which is ultimately the new direction of focus for SAP. While in practice becoming an intelligent enterprise is far from simple, it's not the pipe dream that it once was. Indeed, the technology is already (largely) available—the key challenge for most organizations is ensuring that they have the necessary introspection and ability to change to maximize the potential benefits of digital technology. Whether a business can embrace this change will, in many cases, determine the success of the entire company in our modern landscape.

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Index

A

Abakus 51, 62
Account-based CO-PA 299
Accounts payable (AP) 256, 272
  authorizing and sending payment 273
  matching and approval 273
Accounts receivable (AR) 255, 269
  accounting functionality 270
Acknowledgment 164
Active monitoring 357
Activity 482
Adapter SDK 467
Address cleanse 449
Administration 491
  road ahead 511
Administrative overhead 291
Advanced Business Scripting Language (ABSL) 66
Age debt report analysis 269
Agent productivity 117
Alert store 507
Alerts 507
Amazon 126
Analytical applications 426
Analytics 411
  processing 373
  road ahead 431
Apache Hadoop 373
API Designer 480, 481
API economy 479
API Portal 480
Application integration 463
  on-premise 470
  road ahead 488
  strategy 465
Application platforms 375
Application programming interfaces (APIs) 464, 479, 488
  calls 467
Application software 365
Approvals 60
Ariba Network 139, 141, 149, 164, 166
Artificial intelligence (AI)
  customer service 78, 79, 82
ASAP 516
Assemble-to-order (ATO) 181
Assembly 218
Asset accounting 263, 275
  classic 276
Asset Health Control Center 226
Asset Intelligence Repository 228
Asset management 211
  road ahead 230
  SAP S/4HANA 217
Asset operations 228
Assets 255, 261, 275
Availability checking 98, 99

B

Bad data 435, 436, 445
  impacts 446
Balance calculation 266
Balance sheet 254, 255
Basic warehouse management 195, 196
Batch management 201
Behavioral data 53
Benchmarking 510
Best practices
  administration 493
  business process example 495
Best price evaluation 157
Big data 225, 406, 409
  insight 407
Bill of material (BOM) 183
  equipment 218
  functional location 218
Billing 88, 268
  sales billing functionality 108
Billing and revenue management 105
  models 106
Billing cockpit 244
Billing plan management 244

Blockchain 127, 236, 382
Bottleneck items 157
Branch/division profitability 299
Bucket 497
Budgeting 294
Business intelligence (BI) 413
bimodal 419, 425
modern 415, 416
traditional 414
Business network 94, 101
Business process analytics 509, 510
Business Process Change Analyzer 503
Business process flow (BPF) 297
Business process management (BPM) 381
Business processes 494
Business projects 301
Business rules 477
Business to business (B2B)
business networks 95
commerce 72
customer service 113
integration add-on 474
sales 63, 67
Business to consumer (B2C) 36, 47
customer service 81, 112
Business to employee (B2E) 87

C

Calculation engine 428
Callidus Cloud 67
Campaign management 58, 70
content capability 59
Capacity leveling 184
Capacity requirements planning (CRP) 184
Carrying cost 125
Case 482
Cash and liquidity management 284
Cash collection 269
Cash equivalents 255
Cash flow statement 257, 258
Central Finance 281
Central governance 443, 444
Change document 502
Change request 244
Channels 73
Charging 109
Chart of accounts 261
cost/revenue elements 292
country-specific 261
Chatbots 78, 171
Classic reporting 426
Cleansing rules 453
Client software 364
Client-server architecture 364, 365
Closing balances 266
Cloud 463
vs. on-premise 40
Cloud connector 272
Cloud Foundry 376
Cloud integration 466
Cloud-first strategy 48
Code pushdown 371
Columnar storage 368
Commerce 70
challenges 71
data 72
Commercial project management 242
Committed capital 125
Compensation management 329
Complex contingent engagements 340
flow 341
Complex projects 300
Complex service model 113, 116
Compliance 283
Concur Detect 352
Concur Drive 352
Concur Expense 345, 350, 351
additional functionality 351
Concur Invoice 274, 275
Concur Locate 347, 357
Concur Request 345, 347, 355
Concur Travel 345, 347, 352
additional functionality 355
Concur TripLink 355
Condition-based monitoring 226
Configure, price, quote (CPQ) 69
Configure-to-order (CTO) 181
Connectivity add-on 475
Consensus demand planning 129
Consignment stock 203
Construction project 300

Contact centers 78, 116
Contextual data 53
Contingent labor 145, 336
Contingent workforce 333
road ahead 343
Contract 92
Contract management 244, 278
Controllable cost 291
Conversational user interface (CUI) 387
Conversion rules 452
Cost analysis 292
Cost centers 440, 444
Cost control 295
Cost estimation 295
Cost management 290
flexible hierarchies 292
SAP S/4HANA 292
Cost of goods sold (COGS) 253
split functionality 292
Cost-based CO-PA 299
Credit management 98, 99
Credit utilization report 269
Currency conversion 279
Customer acquisition 268
Customer experience 47, 117
IT challenges 49
road ahead 85
Customer financials 110
Customer Interaction Center 114
Customer journey 56
Customer Journey Builder 59
Customer Journey Insight 56
Customer profitability 298
Customer relationship management (CRM) 47
Customer service 75, 88, 111
challenges 77
channels 78
models 112
Customer service deployment 114
hybrid 115
SAP C/4HANA standalone 115
SAP S/4HANA standalone 114
Cycle counting 198
Cycle stock 135

D

Data 83, 86, 435
architecture 440
challenges 84
compression 369
discover and measure 447
discovery 418
flows 417
governance 418
modeling 417, 418
monitor and improve 449
orchestration 418
ownership 439
policies 439
quality 372
replication 372
Data access 371
Data cleanse 450
Data Dictionary 439
Data governance 440
complicance 441
data model 441
process 441
usability 441
Data lifecycle management 439
Data migration 451
designing 452
executing 453
phases 452
planning 452
reconciling 453
Data modeling 370
Data privacy 61
Data profiling 447
Data quality and remediation 445
quality cycle 447
Data quality KPIs 439
Data strategy 438
building blocks 438
Data warehouse 391, 394
road ahead 408
solutions 403
Database and platform 361
architecture 363
core components 364

Database and platform (Cont.)
road ahead 388
siloed approach 362
Database management system (DMBS) 366
Database software 366
Database technology 366, 368
Day ledger 260
Days sales outstanding (DSO) 251, 270
Decision table 478
Deep learning 389
Delinquency management 269
Delivery management 98, 99
Dell Boomi 317
Demand forecast 128
Demand management 132
Demand sensing 132, 141
Depreciation 276
Detect-to-correct (D2C) 492, 506
incidents 508
monitoring 507
optimizing 509
problems 508
Developer portal 480
DevOps 379
Diagnostic agents 507
Digital assistants 387
Digital disruption 31
Digital economy 126
Digital network 170
Digital optimization 32
Digital transformation 30, 514
begin with the end 33
business case 33
plan into action 34
Direct costs 291
Direct expenses 291
Direct labor 291
Direct material 291
Discrete manufacturing 173
Distribution channel profitability 298
Distribution profiling 449
Document management 98, 100
Dun & Bradstreet 155, 156

E

Earnings before interest and taxes (EBIT) 253
E-commerce 94
EDI converter 474
Electronic Bank Account Management (eBAM) 286
Electronic data integration (EDI) 474
Eliminations 279
Embedded analytics 268, 405
Embedded EWM 178, 204
in SAP S/4HANA,SAP Fiori dashboard 204
key functionality 204
resource management 205
Embedded TM 206
dashboard 206
key features 207
Employee data 314
Engine Management System (EMS) 216
Engineer-to-order (ETO) 182
Enterprise information management (EIM) 435
road ahead 458
Enterprise performance management (EPM) 427
road ahead 432
Entitlement 76
Equipment 217
Equity 261
Everything as a service (EaaS) 390
Excess inventory 124
Exclusion criteria 453
Expense 345, 349
cycle 349
making a claim 350
reimbursement 350
Expense entries 266
Expense Pay Global 352
ExpenseIT 351
Exposure monitoring report 269
Extended sales cycle 67
Extended warehouse management (EWM) 195, 203
Extension ledgers 260, 264
Extract 398

Extract, transform, load (ETL) 398, 401
tools 399

F

Facebook 59
Facilities and storage costs 125
Fast-moving consumer goods 72
Field service 79, 95, 116
File Transfer Protocol (FTP) 467
Finance 249
Finance integration 98, 100
Finance lease 277
Financial accounting (FI) 249
determination 263
road ahead 286
versus management accounting 287
Financial adjustments 266
Financial close 265
Financial consolidation 278, 280
Financial Statement – Grid-Based app 268
Financial statements 252
displaying 267
Financing activities 257
Finished goods inventory 136
Fixed assets 256, 275
lifecycle 276
Fixed recurring model 107, 110
Flexible Real Estate Management (RE-FX) 278
Flow ruleset 478
Focused Build 510
Focused Insights 510
Focused solutions 505, 510
Forecast adjustment 128
Forecasting 294
Foundation objects 314
Freight execution 208
Freight management 208
Freight order 208
Freight settlement 208
Freight unit 208
Fulfillment 126
Functional location 217

G

G/L account 259, 261, 262
General Data Protection Regulation (GDPR) 59, 307
General Ledger (G/L) 258
integrations 260
new 250, 259, 264
Generally Accepted Accounting Principles (GAAP) 252
Geocoding 450
Gig economy 168
Gigya 51, 62
Goals Library 327
Goods issue 197
Goods receipt 197
Governance 282
Governance, risk, and compliance (GRC) 282
Graph engine 373
Gross profit 253
Group reporting 280
Guided procedures 506

H

Hadoop 406, 417, 456
Handling costs 125
Healix 357
Heuristics 185
Hire-to-retire process 309
Human resources (HR) 307, 312, 335
business processes 310
road ahead 331
transactions 314
Hybrid landscape 463
Hybris 48

I

iFlow 467
IFRS 15 ..... 251, 286
IFRS 16 ..... 251, 277
Incentive and commission management 101
functionality 101
Income entries 266
Income statement 253, 254

Indirect costs 291
Initiative 497
Innovation management 235
Innovation Office 236, 237
Inquiry 91
Intangible assets 256
Integrated planning 296
Integration platform as a service (iPaaS) 466
Integration Solution Advisor Methodology (ISA-M) 465
Intelligence 356
dashboards 356
Intelligent enterprise 388, 429, 520
Intemediary document (IDoc) 474
Interest expense 253
International Accounting Standard (IAS) 17 277
International Financial Reporting Standards (IFRS) 252
International Organization for Standardization (ISO) 282
Internet of Things (IoT) 127, 171, 189, 224, 375, 382
asset management 214
customer service 77
Inventory 256
Inventory management 133, 195, 196
inventory location 137
inventory quantity 134
inventory state 136
stock 200
storage locations 199
Investing activities 257
Investment management (IM) 302
Invoice management 272
Invoices 268
receiving 273
Invoicing 88, 109, 165
IT projects 300
IT systems 38

J

Java mapping 473
Job posting 338
Journal entries 262

K

Kanban 184
Kanban card 184
Key performance indicators (KPIs) 482
Knowledge management 82
KPI Catalog 509

L

Labor management 206
Lead management 60
Leading ledger 259
Lean 184
Learning and development 324
Lease accounting 277
Leverage items 157
Liabilities 256, 261
Lifecycle costing 239
Line item-based journal processing 264
Load 398
Logical modeling 402
Logical views 402
Logistics execution (LE)
quality management 190

M

Machine learning 141, 270, 383, 389
asset management 226
SAP HANA 374
Maintenance
item 224
management 213
plan 223
strategies 213, 214
strategy 224
Maintenance object structure 218
Major releases 504
Major/minor release model 503
Make-to-order (MTO) 92, 181
Make-to-stock (MTS) 92, 180
Manage Sales Plan app 103
Managed service provider (MSP) 335
Management accounting (CO) 287
road ahead 303

Management accounting (CO) (Cont.)
SAP ERP module ... 289
versus financial accounting ... 287
Manager self-service ... 313
Manufacturing ... 173
road ahead ... 191
supply chain management ... 194
Manufacturing execution ... 186
Manufacturing Execution System (MES) ... 178, 186
Mapping rules ... 452
Marketing ... 51
acquisitions ... 61
analytics ... 60
challenges ... 51
cost and automation ... 54
dashboard ... 61
data ... 52, 53
execution channel ... 58
integrated capabilities ... 54
third parties ... 55
Marketing plan ... 59
Master data ... 53, 380
Master data consolidation ... 443
active records ... 443
source records ... 443
Master data cost elements ... 265
Material ... 218
Material Ledger (ML) ... 263
Material master ... 163, 183
Material requirements planning (MRP) ... 162, 179, 182
run ... 145
Material reservations ... 145
Materials management (MM) ... 175, 185, 262
Matrix structure ... 301
Mediation by DigitalRoute ... 109
Metadata profiling ... 449
Meter-based model ... 107
Microsoft Outlook ... 69
Minor releases ... 504
Mobile technology ... 225
Monitoring store ... 507
Monthly reporting ... 267
MRP cockpit ... 175
Multichannel customer journey ... 52
My Sales Overview app ... 104

N

Natural language processing (NLP) ... 387
Needs analysis ... 155
Neo ... 376
Net income ... 254
Noncritical items ... 157
Nonleading ledger ... 259
Notifications ... 220

O

Obsolescence ... 125
Onboarding ... 319
One-time charge model ... 107, 110
On-hand inventory ... 135
Online analytical processing (OLAP) ... 391
Online retailers ... 72
Online transactional processing (OLTP) ... 391
Operating activities ... 257
Operating expenses ... 253
Operational lease ... 277
Operational planning ... 294
Operational process intelligence ... 485
Order ... 91
Order and contract management ... 88, 90
business models ... 92
common requirements ... 90
SAP S/4HANA ... 96
SAP S/4HANA vs. SAP C/4HANA ... 96
Order channel ... 94
Order management ... 74, 208
Order-to-cash cycle ... 67
Order-to-cash process ... 89, 97
Org Chart ... 316
Overall equipment effectiveness (OEE) ... 189
Overhead expenses ... 253

P

Payroll ... 312, 314, 317
People Profile ... 314
Performance and compensation ... 327

Performance management 327
Personalization 126
Pipeline stock 135
Planned maintenance 81
Planning 293
Planning and forecasting 59
Planning board 185
Planning strategies 174, 179
Plant Maintenance (PM) module 217
Plant, property, and equipment (PP&E) 256
Platform-as-a-service 41
Portfolio and project management 241
Portfolio item 497
Portfolio management 242, 303, 496
Portfolio-to-project (P2P) 492, 496
Position management 316
Post-hire verification 323
Posting periods 267
Predictive analytics 421, 429
Predictive Analytics Library (PAL) 430
Predictive data 53
Predictive maintenance 212, 216, 217, 225
SAP S/4HANA 224
Predictive models 61
Predictive technology 65
Preliminary cost estimate 238
Presales 97, 98
Preventative maintenance 215
performance-based 216
SAP S/4HANA 223
Pricing 97, 99
Problem ticket 508
Process explorer 482
Process manufacturing 174
Process mining 481
Process orchestration 470
Procurement 144, 262, 335
direct 162
indirect 145, 162, 163
Procure-to-pay process 482
Product attributes 299
Product configuration 98, 99
Product content management 74
Product lifecycle costing 238
Product review 128
Product safety and compliance 127
Product-as-a-service 93
benefits 94
Production costs 125
Production execution 184
Production overhead 291
Production planning (PP) 175, 178
quality management 190
Production planning and detailed scheduling (PP-DS) 177, 184, 185
Production version 183
Profit and loss (P&L) 253
Profit before interest and taxes (PBIT) 253
Profit center accounting (PCA) 250
Profitability analysis (CO-PA) 293, 297
dimensions 298
SAP S/4HANA 299
Profitability segments 300
Programmable logic controller (PLC) 189
Progress report 243
Project accounting 300
classifying 300
Project Blueberry 404
Project cost and revenue planning 244
Project cost overview reporting 243
Project issue and change management 244
Project issues 498
Project lifecycle 301
Project management 242, 303, 497
analytics and reporting 499
Project Management Institute (PMI) 301
Project systems (PS) 175, 177, 302
Project Workspace app 243
Projects 497
Proxy 315
Pull type 179
Purchase 164
Purchase order (PO) 147, 164
Purchase request 162
Purchase requisition 162
Purchasing 143, 149, 161
Push type 179

Q

Quality management (QM) 177, 189
inspection lots 189

Quality management (QM) (Cont.)
notifications 190
Quality notification 177
Quotation 91
Quotation costing 239

R

Radio frequency (RF) framework 204
Radio frequency identification (RFID) 205
Raw materials 136
RDS packages 456, 457
Reactive maintenance 81, 214
SAP S/4HANA 220
Reactive sourcing 150
Real estate management 277
Real-Time Consolidation (RTC) 280, 281
Receipt Audit 352
Receivables management 268
Receiving 165
Reconciliation rules 453
Recovery 269
Recruiting 319
process 320
Regional profitability 299
Relationship-based selling model 65
Remote synchronization 372
Repetitive manufacturing 173, 494
Request for information (RFI) 158
Request for proposal (RFP) 158
Request for quotation (RFQ) 147, 151, 208
SAP S/4HANA 152
Request-to-fulfill (R2F) 492, 505
Requirement-to-deploy (R2D) 492, 500
demand 500
deployment 503
design 501
development 502
steps 500
test 502
Research and development (R&D) 233, 300
pipeline 234
Resource management 242, 303
Resource planning 295
Response and supply management 137
Response planning 138, 139
Retained earnings 256
Return on investment (ROI) 485
Returns 126
Revenue 88
planning 70
Risk management 282
Risks 282, 497
Roadmap viewer 498
Role-based authorizations 313
Role-based permissions (RBPs) 315
Rules Composer 477
Rules Engine 477
Rules Manager 477
Ruleset 477
Runtimes 381

S

Safety stock 135
Sales 62
challenges 63
customer 63
firm 65
new technology 64
salesperson 64
Sales analytics 104
Sales and distribution (SD) 87, 105, 263
quality management 190
road ahead 117
Sales and operations planning (S&OP) 123, 124
Demand planning 127
executive review 131
pre-S&OP review 131
supply review 129
Sales and service
road ahead 117
supply chain management 194
Sales forecasting 102
Sales forecasting application 100
Sales Manager Overview app 104
Sales order 174
Sales order stock 203
Sales Performance – Plan/Actual app 103
Sales planning and performance management 88, 100

Sales revenue 253
Salesforce 85
SAP Activate 495, 499, 516
SAP Advanced Planning and Optimization (SAP APO) 121, 177
SAP Analysis for Microsoft Office 426
SAP Analytics Cloud 331, 420, 426, 431
business intelligence 420
planning 421
predictive analytics 421
SAP Digital Boardroom 421
SAP Analytics Hub 423, 426
SAP API Business Hub 468, 469
SAP API Management 479
SAP Ariba 143, 147, 148
invoicing 166
road ahead 171
SAP Ariba Buying 163
SAP Ariba Contracts 159
SAP Ariba Discovery 158
versions 158
SAP Ariba Invoice Management ... 167, 274, 275
SAP Ariba Payables 274, 275
SAP Ariba Sourcing 144, 159
SAP Ariba Spend Analysis 155, 157
SAP Ariba Start Sourcing 159
SAP Ariba Supplier Information and Performance Management 160
SAP Ariba Supplier Lifecycle and Performance 160
SAP Ariba Supplier Risk 160
SAP Asset Intelligence Network 228, 231
SAP Asset Strategy and Performance Management 229
SAP Audit Management 283
SAP Best Practices 35
SAP Best Practices Explorer 312
SAP Business Planning and Consolidation (SAP BPC) 296, 427
11.0 280
embedded 428
SAP Business Planning and Consolidation for SAP S/4HANA 296, 297
SAP Business Process Management (SAP BPM) 475
business process example 476
SAP Business Rules Management (SAP BRM) 477
SAP Business Suite 39
SAP Business Warehouse (SAP BW) 38, 391, 392, 395, 412
embedded analytics 406
evolution 399
limitations 397
on SAP HANA 400, 404
SAP BusinessObjects Business Intelligence (SAP BusinessObjects BI) 423
approach 424
components 426
SAP BusinessObjects Design Studio 395
SAP BusinessObjects Web Intelligence 426
SAP BW/4HANA 280, 296, 400, 401, 425
key functionality 402
migration 403
migration paths 404
native SQL 402
road ahead 409
SAP C/4HANA 47, 48, 62, 118
customer service 77
deploying 50
process orchestration 476
SAP Cash Application 270, 286
SAP Cloud for Customer 66
SAP Cloud for Marketing 55
SAP Cloud Identity Access Governance 283
SAP Cloud Integration Automation Service 489
SAP Cloud Platform 43, 375, 466, 479
analytics 378
business services 378
capabilities 378
collaboration 378
data management 379
developer experience 379
integration 380
orchestration 380
SAP Leonardo capabilities 382
security 381
SAP Cloud Platform Big Data Services 419
SAP Cloud Platform cockpit 377
SAP Cloud Platform Integration 317, 466
adapters 467

SAP Cloud Platform Integration (Cont.)
connectivity ... 467
integration flow ... 469
mapping ... 468
road ahead ... 488
runtime ... 472
SAP Cloud Platform Mobile Services ... 380
SAP Cloud Platform Open Connectors ... 488
SAP Collections and Dispute Management ... 271
SAP Commerce ... 73
SAP Commerce Cloud ... 73, 94, 115
integration ... 74
personalization ... 74
SAP Commercial Project Management ... 243
SAP Concur ... 345
packages ... 346
SAP Connected Assets ... 224, 226, 230
SAP Connected Goods ... 209
SAP CoPilot ... 387
SAP Credit Management ... 271
SAP Crystal Reports ... 426
SAP Customer Consent ... 85
SAP Customer Data Cloud ... 84
SAP Customer Engagement Center ... 83, 115
SAP Customer Identity ... 85
SAP Customer Profile ... 84
SAP Customer Relationship Management (SAP CRM) ... 48, 49, 111
SAP Data Hub ... 408, 417, 419, 420, 425, 459
SAP Data Quality Management ... 450, 459
SAP Data Services ... 56, 447, 449, 456
SAP Digital Boardroom ... 421, 422, 432
SAP Digital Documents by OpenText ... 110
SAP Digital Manufacturing Cloud ... 191
SAP Enterprise Architecture Designer ... 419
SAP ERP ... 37, 367
Financial Accounting (FI) ... 250
SAP ERP Human Capital Management (SAP ERP HCM) ... 310
SAP Expert Guided Implementation ... 510
SAP Extended Warehouse Management (SAP EWM) ... 178, 196, 203
SAP Field Service ... 80
SAP Fieldglass ... 149, 333
complex contingent engagements ... 341
SAP Fieldglass (Cont.)
landscape ... 334
simple contingent work ... 337
work order item list ... 338
SAP Fieldglass Flex ... 343
SAP Financial Closing cockpit for SAP S/4HANA ... 267
SAP Financial Consolidation ... 280
SAP Fiori ... 95, 384, 386
transfer stock ... 198
SAP Fiori applications ... 175, 385
portfolio and project management ... 241
SAP Fiori launchpad ... 293, 385
SAP Governance, Risk and Compliance
embedded ... 283
SAP GUI ... 364, 365, 385
SAP HANA ... 38, 66, 367, 400, 416, 419
analytics processing ... 373
business functions ... 374
compression ... 369
data governance ... 442, 450
data modeling ... 370
database services ... 368
embedded analytics ... 406
integration ... 373
multicore utilization ... 368
multitenacity ... 369
multitier storage ... 369
operational process intelligence ... 485
predictive functions ... 374
road ahead ... 519
search functions ... 374
virtualization and federation ... 371
SAP HANA Cloud Platform ... 376
SAP HANA Data Management Suite ... 418
SAP HANA smart data access ... 456
SAP HANA smart data integration ... 449, 450, 456
road ahead ... 458
SAP HANA smart data quality ... 448, 450, 457
road ahead ... 458
SAP Hybris Billing ... 105
SAP Hybris Marketing Cloud ... 55
SAP Information Steward ... 447, 449
data profiling ... 448

SAP Innovation Management 233, 235
reporting 237
SAP Integrated Business Planning (SAP IBP) 121, 123, 131, 177
dashboards 132
for demand 122, 132, 141
for inventory 122, 133–135, 137
for response and supply 122, 137, 138
for sales and operations 122, 128, 130–132
road ahead 141
supply chain management 193
SAP Invoice Management by OpenText 165, 273, 275
SAP Jam 69, 83, 131, 138
SAP Legacy System Migration Workbench 457
SAP Leonardo 44, 66, 230, 270, 382
Connected Assets 225
SAP Lumira 61, 395
architecture 397
SAP Lumira, designer edition 396, 426
SAP Lumira, discovery edition 396, 426
SAP Manufacturing Execution 178, 187
key features 187
quality management 190
SAP Manufacturing Integration and Intelligence 178, 187
hub role 188
quality management 190
SAP Manufacturing Suite 178, 186
road ahead 191
SAP Marketing Cloud 51, 55
capabilities 56
SAP Master Data Governance
road ahead 458
SAP Master Data Governance (SAP MDG)
key capabilities 442
SAP Master Data Management 442
SAP Multibank Connectivity 274
SAP NetWeaver Application Server for Java 471
SAP Operational Process Intelligence 485, 510
benefits 486
real-time dashboard 486
SAP Payroll Processing 317
SAP Plant Connectivity 178, 189
SAP Portfolio and Project Management 234, 241
benefits 241
SAP Predictive Analytics 430
SAP Predictive Maintenance and Service 226
SAP Process Control 283
SAP Process Integration 471, 472
adapters 473
add-ons 474
data routing 473
SAP Process Mining by Celonis 481, 483, 485, 510
SAP Process Orchestration 466
architecture 471
dual-stack 472
road ahead 488
SAP Product Lifecycle Costing 233, 238
calculations 240
deploying 239
SAP Product Lifecycle Management 239
SAP Profitability and Performance Management 428
SAP Risk Management 283
SAP S/4HANA 29, 37, 39
asset management 211
data governance 442
financial accounting 249
integration 473
management accounting 287
manufacturing 173
MRP 182
notifications 220
on-premise 41
order screen 222
private cloud 42
products 40
sales 62
sales and service 87
sourcing and procurement 143
suite 40
supply chain management 193
SAP S/4HANA Cloud 41, 42
SAP S/4HANA Cloud for credit integration 271

SAP S/4HANA Cloud for customer payments ... 272
SAP S/4HANA Enterprise Management ... 39, 146, 182, 212
direct procurement ... 162
indirect procurement ... 163
inventory management ... 199
preventative maintenance ... 223
production planning ... 184
reactive maintenance ... 220
reactive sourcing ... 151
services procurement ... 168
sourcing and procurement ... 146, 148
supply chain management ... 196
tactical sourcing ... 152
SAP S/4HANA Finance ... 250, 263
SAP S/4HANA Finance for group reporting ... 281
SAP S/4HANA Finance for receivables management ... 270
SAP S/4HANA for customer management ... 113
SAP S/4HANA migration cockpit ... 455
SAP S/4HANA Migration Object Modeler ... 455
SAP S/4HANA R&D/Engineering ... 233, 234
SAP Sales Cloud ... 62, 66
integration ... 69
SAP Service Cloud ... 80, 115
SAP Simple Finance ... 250
SAP Solution Manager ... 491, 494
best practices ... 494
incident management ... 508
portfolio and project management ... 496
process management ... 501
road ahead ... 511
service options ... 504
system monitoring ... 507
work packages ... 501
SAP Spend Performance Management ... 154
SAP SuccessFactors ... 307
calibration ... 328
road ahead ... 331
strategy ... 308
SAP SuccessFactors Compensation ... 329
SAP SuccessFactors Employee Central ... 310, 312
time and attendance ... 318
SAP SuccessFactors Employee Central Payroll ... 317
journal entries ... 263
SAP SuccessFactors HCM Suite ... 309, 311
best practices ... 312
SAP SuccessFactors Learning ... 325
SAP SuccessFactors Mobile ... 326
SAP SuccessFactors Onboarding ... 322
activities ... 323
mobile app ... 323
new hire checklist ... 324
SAP SuccessFactors Performance & Goals ... 327, 328
SAP SuccessFactors Recruiting ... 320
career site ... 321
talent pipeline ... 322
SAP SuccessFactors Succession & Development ... 326, 327
succession planning ... 326
SAP SuccessFactors Workforce Analytics ... 330
reporting center ... 330
SAP SuccessFactors Workforce Planning ... 330
SAP Supplier Relationship Management (SAP SRM) ... 144
SAP Supply Chain Control Tower ... 122, 139
dashboard ... 140
SAP Transformation Navigator ... 191
SAP Transportation Management ... 206
SAP Vehicle Insights ... 209
SAP Vora ... 408, 418
Scrapping ... 125
Seat- or meter-based model ... 110
Secondary cost elements ... 265
Secure connectivity add-on ... 475
Secure File Transfer Protocol (SFTP) ... 467, 475
Segmentation ... 57, 61
Self-service ... 79, 82
Semantic profiling ... 448
Serial number ... 218
Serialization ... 202
Series engine ... 375
Service Catalog ... 505
Service fulfillment ... 506

Service level agreements (SLAs) 508
Service request 506
Service sheets 170
Service/production projects 300
Service-oriented architecture (SOA) 378
Services procurement 167
processing 169
purchasing 168
Settlement rule 222
Share capital 256
Shareholders' equity 256
Shelf life expiry dates (SLDs) 202
Shipping notification 164
Simple contingent work 336
engage 338
flow 337
pay 339
procure 339
Simple projects 300
Simple service model 112, 116
Single customer view 56, 69
Single-level optimization 135
Smart data access (SDA) 371
Smart data integration (SDI) 372
SmartEdit 74
Software as a service (SaaS) 37, 41, 464
Solution Readiness Dashboard 501, 503
Sourcing 143, 148, 150
Sourcing and procurement 143
road ahead 170
SAP solutions 146
supply chain management 193
Spatial engine 373
Special stock 181, 203
Spend analysis 154
Sprinklr 62
Statement of work (SoW) 340, 342
Stock
cumulative 201
moving between locations 198
type 199
Stock outs 124
Strategic item 156
Strategic planning 138, 293
Strategic sourcing 153
implementation path 158
Strategic sourcing (Cont.)
negotiate and select suppliers 159
profile the category 154
sourcing strategy 156
supplier portfolio 157
vendor lifecycle and performance 159
Streaming analytics 375
Subcontract manufacturing 185
Subcontract stock 203
Subscription order management 109
Subscription service 106
Supervisory Control and Data Acquisition (SCADA) 217
Supply chain analytics 139
Supply chain management 193
road ahead 209
Supply chain planning 121
road ahead 140
Supply market analysis 155, 159
Supply planning 137
operational 139
strategic 138
Supply review inputs 130
Survey management 70
SurveyMonkey 62

T

Table
ACDOCA 264
ACDOCP 290
Tactical planning 293
Tactical sourcing 151
Talent community 321
Talent management 307
road ahead 331
Target inventory 135
Tax service 378
Taxes 254
Tendering 208
Test Automation Framework 503
Test case 502
Test defect 503
Test plan 502
Text analytics 374
Time and attendance 317

Time and expense management 345
Time off 318
Time sheets 318
Transaction MIGO 197
Transactional data 53
Transactions 262
Transfer of requirements 98, 99
Transform 398
Transportation management 206
Travel 345, 352
Travel and expense management 145
monitoring 357
reporting 356
road ahead 357
Travel management companies (TMCs) 353
direct 354
indirect 354
Traveler profile 354
Treasury management 284
reporting 285
TripIt 355

U

Uncontrollable cost 291
Universal Journal 250, 260, 264, 286, 290
ledger 265
Usage-based model 107, 110
User experience (UX) 381
sales 68
User experience (UX) (Cont.)
SAP Fiori 385
unified 389
User interface (UI) 383
options 475
SAP Fiori 385

V

Validation rules 453
Variable pay 329
Visiprise 186

W

Web self-service 116
What-if analysis 130
Work breakdown structure (WBS) 302
Work center 183
Work items 502
Work order 221, 339
Work packages 501
Workflow 315
Workforce planning and analytics 330
Work-in-progress (WIP) materials 136
Work-in-progress (WIP) report 243

X

XLST mapping 473

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